United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
the Minnesota Agricultural
Experiment Station

Soil Survey of Meeker County, Minnesota

Part I

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How to Use This Soil Survey

This survey is divided into three parts. Part I includes general information about the survey area; descriptions of the general soil map units, detailed soil map units, and soil series in the area; and a description of how the soils formed. Part II describes the use and management of the soils and the major soil properties. This part may be updated as further information about soil management becomes available. Part III includes the maps.

On the **general soil map**, the survey area is divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** in Part I of this survey for a general description of the soils in your area.

The **detailed soil maps** can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**. Note the number of the map sheet, and turn to that sheet.

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** in Part I of this survey, which lists the map units by symbol and name and shows the page where each map unit is described.

The **Contents** in Part II shows which table has data on a specific land use for each detailed soil map unit. See the **Contents** in Part I and Part II for other sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1992. Soil names and descriptions were approved in 1996. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1992. This survey was made cooperatively by the Natural Resources Conservation Service, the Minnesota Agricultural Experiment Station, the Agricultural Extension Service, the Minnesota Department of Natural Resources, and the Board of Water and Soil Resources. The survey is part of the technical assistance furnished to the Meeker County Soil and Water Conservation District. Partial funding was provided by the Legislative Commission on Minnesota Resources and by the Meeker County Board of Commissioners.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

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Cover: This nearly level to gently undulating landscape is in an area of Cosmos, Kandiyohi, Lura, and Strout soils in the southern part of Meeker County.

Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service home page on the World Wide Web. The address is http://www.nrcs.usda.gov (click on "Technical Resources").

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Foreword

This soil survey contains information that can be used in land-planning programs in Meeker County, Minnesota. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service.

William Hunt
State Conservationist
Natural Resources Conservation Service

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Soil Survey of
Meeker County, Minnesota

By Robert A. Lueth, Natural Resources Conservation Service

Fieldwork by Robert A. Lueth and Douglas E. Miller, Natural Resources Conservation Service, and Norman D. Kuhlman, Minnesota Agricultural Experiment Station

United States Department of Agriculture, Natural Resources Conservation Service,
in cooperation with
the Minnesota Agricultural Experiment Station

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind or segment of the landscape. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landscape, soil scientists develop a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientists to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Individual soils on the landscape commonly merge into one another as their characteristics gradually change. To construct an accurate map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of soil-vegetation-landscape relationships, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, soil reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

The descriptions, names, and delineations of the soils in this survey area do not fully agree with those of the soils in adjacent survey areas. Differences are the result of a better knowledge of soils, modifications in series concepts, or variations in the intensity of mapping or in the extent of the soils in the survey areas.

General Nature of the Survey Area

Meeker County is near the center of the southern half of Minnesota (fig. 1). It has a total land area of 457,100 acres. About 4,840 acres of this total is water. Litchfield, the largest community and the county seat, is near the center of the county. In 1992, the population of Meeker County was 21,030 and that of Litchfield was 6,082.

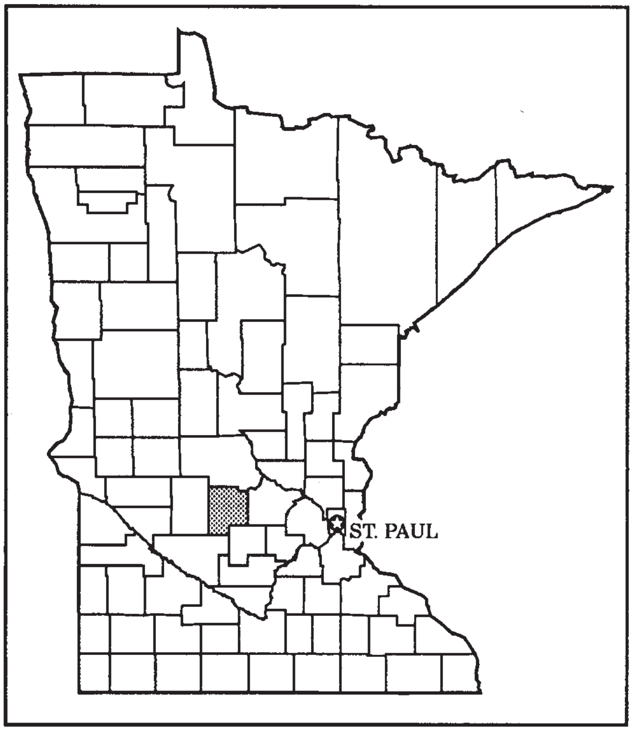

Figure 1.—Location of Meeker County in Minnesota.

History

The Lakota Indians inhabited the survey area when the first European settlers arrived. Meeker County was established in 1856, the same year settlement began. The county was named for B.B. Meeker of St. Anthony, one of the town's first settlers. At that time the western part of the county was part of a vast prairie characterized by tall prairie grasses as high as a man's shoulder (Lamson). The eastern half of the county formed part of the western boundary of the "Big Woods." The prairie and woodlands include numerous lakes and streams and marshes. The soils in the county, which formed in young glacial deposits, were for the most part highly productive. As a result, farming enterprises developed. About 75 percent of the area is cropland. The principal crops are corn and soybeans. Minor acreages of oats, hay, and specialty crops, such as peas, sweet corn, and sugar beets, are also grown. The major livestock produced in the county are hogs, dairy cattle, and poultry, particularly turkeys.

Soils of Meeker County

The soils in Meeker County are very deep and dark or moderately dark. Slopes are mostly gently sloping but range from nearly level to very steep. The soils formed in silty and clayey glacial lacustrine sediments; in loamy, silty, and clayey glacial till; and in glacial outwash with a thin mantle of loamy sediment. Native vegetation in the southwestern part of the county was tall prairie grasses, except in closed depressions. Except in closed depressions, the southeastern and northern parts of the county and areas bordering lakes and streams supported mixed northern hardwoods. Nearly all of the depressions in the county are lakes or marshes covered with reeds, sedges, and other wetland species.

Physiography, Drainage, and Geology

Metamorphic and igneous rocks, some of the earth's oldest rocks, form the lowermost geologic unit in Meeker County. The rocks are mainly granites, gneisses, and schists of Precambrian age.

In the northern part of the county, a thin layer of fine grained sedimentary rock lies above the igneous and metamorphic rocks. Cretaceous shale is the uppermost bedrock layer in most of the county, but this layer is absent in a diagonal belt making up most of Swede Grove and Manannah Townships in the northwestern part of the county (Sims, 1970).

The bedrock is covered to a depth between 200 and as much as 400 feet by glacial deposits. Meeker County lies in an area where several glaciers advanced and retreated during the great ice age. The ice age is referred to by geologists as the Pleistocene Epoch of the Quaternary period. The ice age began about 2 million years ago and ended about 10,000 years ago. As the ice melted, sediment carried on and in the ice was deposited as moraines, outwash plains, stream terraces, and lake plains. Unsorted sediments of loamy to clayey material containing cobbles and stones were deposited in moraines. In places, meltwater from the glaciers carried sediment beyond the borders of the moraines. The meltwater sorted the glacial sediment and deposited gravelly and sandy sediments on outwash plains and stream terraces. Mostly silty and clayey sediments were deposited in lakes. When they dried up, these lakes became lake plains.

The topography of the moraines is disordered and complex. It is characterized by knolls and hills of irregular shape and size intermingled with swales and numerous closed depressions. The moraines are in the northern and southern parts of the county. Most of the lakes in the county are within moraines.

The central part of the county consists of glacial outwash plains and glacial lake plains of mostly silty and clayey sediment. Narrow discontinuous stream terraces or benches occur along the North Fork and Middle Fork of the Crow River and along the South Fork of the Crow River in the southeastern part of the county.

Relief ranges from 50 feet to about 100 feet on the moraines in the eastern part of the county, in a small area near Lake Koronis in the northwestern part of the county, and in a small area in the west-central part of the county. Relief in the other morainic areas ranges from 5 feet to less than 50 feet. The outwash plains, stream terraces, and lake plains have relief of generally less than 20 feet. The highest elevation in the county is about 1,250 feet. This elevation occurs in the northeastern and northwestern parts of the county. The lowest elevation is about 1,000 feet at the point where the North Fork of the Crow River leaves the county.

Meeker County is predominantly drained by the North and South Forks of the Crow River. A small area in the northeastern part of the county is drained by the Clearwater River system.

The North Fork of the Crow River enters the county from Lake Koronis in the northwestern part of the county and winds its way southeastward through the northern part of the county. About a mile east of the village of Lundlake, it is joined by the Middle Fork, which enters the county from Kandiyohi County. Near Manannah the North Fork also receives a tributary that is the outlet of Acton and Hope Lakes in the west-central part of the county. Other main tributaries to the North Fork are Jewitt Creek, which is the outlet of Lake Ripley and joins the North Fork about 2$^1/_2$ miles west of the village of Forest City, and Eagle Creek, which is the outlet of Lake Francis, Lake Washington, and Lake Stella in the southeastern part of the county and the outlet of Swan, Collinwood, and other lakes. These tributaries enter the North Fork near the Wright County line a few miles east of Kingston.

The South Fork of the Crow River flows through the southern part of the county. Its largest tributary is the outlet of Cedar, Willie, and Harding Lakes (Lindholm and others, 1974).

Climate

Meeker County is cold in winter and quite hot in summer. Occasional cool spells occur in summer. Precipitation frequently occurs as snowstorms during the winter and as showers, which are often heavy, during the warmer months, when warm, moist air moves in from the south. The total annual rainfall is normally adequate for corn, soybeans, and small grain.

The three tables at the end of this section provide climate information for the survey area as recorded at Litchfield in the period 1961 to 1990.

In winter, the average temperature is 15 degrees F and the average daily minimum temperature is 5 degrees. The lowest temperature on record, which occurred at Litchfield on January 9, 1977, is -37 degrees. In summer, the average temperature is 70 degrees and the average daily maximum temperature is 82 degrees. The highest temperature, which occurred at Litchfield on August 1, 1988, is 104 degrees.

Growing degree days are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 27.55 inches. Of this, 20.47 inches, or about 74 percent, usually falls in April through September. The growing season for most crops falls within this period. The heaviest 1-day rainfall on record was 6.08 inches at Litchfield on June 17, 1957. Thunderstorms occur on about 35 days each year, and most occur in June.

The average seasonal snowfall is 39.7 inches. The greatest snow depth at any one time during the period of record was 36 inches. On an average, 14 days per year have at least 1 inch of snow on the ground. The heaviest 1-day snowfall on record was 18 inches.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 83 percent. The sun shines 69 percent of the time possible in summer and 51 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 10 miles per hour, in April.

Temperature and Precipitation

(Recorded in the period 1961-90 at Litchfield, Minnesota)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	21.0	0.9	10.9	47	-30	0	0.72	0.24	1.17	2	8.3
February---	27.2	6.6	16.9	51	-26	1	.76	.22	1.23	2	6.9
March------	39.6	20.4	30.0	69	-14	37	1.56	.79	2.23	3	9.0
April------	57.5	34.5	46.0	85	13	226	2.41	1.14	3.51	5	1.4
May--------	71.4	46.4	58.9	92	26	585	3.24	1.96	4.39	6	.0
June-------	80.3	56.1	68.2	96	38	845	4.70	2.49	6.65	7	.0
July-------	84.6	61.3	73.0	98	46	982	3.83	1.92	5.49	6	.0
August-----	81.7	58.4	70.1	96	41	923	3.31	1.67	4.74	5	.0
September--	72.3	48.5	60.4	92	27	611	2.98	1.56	4.22	5	.0
October----	60.4	37.7	49.1	84	17	295	1.99	.61	3.24	3	.1
November---	40.7	23.4	32.1	66	-6	41	1.27	.40	2.05	3	6.3
December---	25.1	7.8	16.5	49	-23	1	.78	.28	1.19	2	7.6
Yearly:											
Average---	55.2	33.5	44.3	---	---	---	---	---	---	---	---
Extreme---	104	-37	---	99	-31	---	---	---	---	---	---
Total-----	---	---	---	---	---	4,548	27.55	21.57	32.91	49	39.7

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

Freeze Dates in Spring and Fall

(Recorded in the period 1961-90 at Litchfield, Minnesota)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 23	May 8	May 18
2 years in 10 later than--	Apr. 19	May 3	May 13
5 years in 10 later than--	Apr. 10	Apr. 23	May 4
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 2	Sept. 20	Sept. 14
2 years in 10 earlier than--	Oct. 7	Sept. 26	Sept. 19
5 years in 10 earlier than--	Oct. 18	Oct. 8	Sept. 29

Growing Season

(Recorded in the period 1961-90 at Litchfield, Minnesota)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	162	140	125
8 years in 10	170	149	133
5 years in 10	184	165	146
2 years in 10	198	180	160
1 year in 10	205	189	168

General Soil Map Units

The general soil map in this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The soils or miscellaneous areas making up one unit can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils or miscellaneous areas can be identified on the map. Likewise, areas that are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The general soil map units in this survey have been grouped for broad interpretive purposes. The broad groups and the map units in each group are described on the following pages.

Organic Soils and Nearly Level to Moderately Steep, Loamy Soils That Formed in Till; on Moraines

1. Canisteo-Okoboji-Nicollet Association

Setting

Landform: Moraines
Position on the landform: Nearly level areas and rims of depressions, depressions, and low summits and backslopes
Slope range: 0 to 3 percent

Composition

Percent of survey area: 3
Extent of components in the association:
Canisteo and similar soils—32 percent
Okoboji and similar soils—23 percent
Nicollet and similar soils—11 percent
Soils of minor extent—34 percent

Soil Properties and Qualities

Canisteo

Drainage class: Poorly drained
Parent material: Till
Surface texture: Clay loam

Okoboji

Drainage class: Very poorly drained
Parent material: Lacustrine deposits over till
Surface texture: Silty clay loam

Nicollet

Drainage class: Somewhat poorly drained
Parent material: Till
Surface texture: Clay loam

Minor Soils

- Clarion and similar soils
- Storden and similar soils
- Swanlake and similar soils
- Muskego and similar soils

2. Clarion-Hamel-Storden Association

Setting

Landform: Moraines
Position on the landform: Backslopes and summits of low hills, footslopes and narrow drainageways, and shoulders
Slope range: 0 to 12 percent

Composition

Percent of survey area: 7
Extent of components in the association:
Clarion and similar soils—34 percent
Hamel and similar soils—17 percent
Storden and similar soils—12 percent
Soils of minor extent—37 percent

Soil Properties and Qualities

Clarion

Drainage class: Well drained
Parent material: Till
Surface texture: Loam

Hamel

Drainage class: Poorly drained
Parent material: Colluvium over till
Surface texture: Loam

Storden

Drainage class: Well drained
Parent material: Till
Surface texture: Loam

Minor Soils

- Glencoe and similar soils
- Klossner and similar soils
- Muskego and similar soils
- Canisteo and similar soils
- Nicollet and similar soils

3. Harps-Nicollet-Webster Association

Setting

Landform: Moraines
Position on the landform: Rims of depressions, low summits and backslopes, and footslopes and shallow drainageways
Slope range: 0 to 3 percent

Composition

Percent of survey area: 6
Extent of components in the association (fig. 2):
Harps and similar soils—32 percent
Nicollet and similar soils—15 percent
Webster and similar soils—15 percent
Soils of minor extent—38 percent

Soil Properties and Qualities

Harps

Drainage class: Poorly drained
Parent material: Till
Surface texture: Clay loam

Nicollet

Drainage class: Somewhat poorly drained
Parent material: Till
Surface texture: Silty clay loam

Webster

Drainage class: Poorly drained
Parent material: Till
Surface texture: Silty clay loam

Minor Soils

- Okoboji and similar soils
- Seaforth and similar soils
- Clarion and similar soils
- Swanlake and similar soils

4. Cokato-Storden-Muskego Association

Setting

Landform: Moraines
Position on the landform: Backslopes and summits, shoulders, and large depressions
Slope range: 0 to 12 percent

Composition

Percent of survey area: 13
Extent of components in the association:
Cokato and similar soils—25 percent
Storden and similar soils—20 percent
Muskego and similar soils—18 percent
Soils of minor extent—37 percent

Soil Properties and Qualities

Cokato

Drainage class: Well drained
Parent material: Till
Surface texture: Loam

Storden

Drainage class: Well drained
Parent material: Till
Surface texture: Loam

Muskego

Drainage class: Very poorly drained
Parent material: Organic materials and coprogenous earth
Surface texture: Muck

Minor Soils

- Le Sueur and similar soils
- Hamel and similar soils
- Glencoe and similar soils
- Okoboji and similar soils

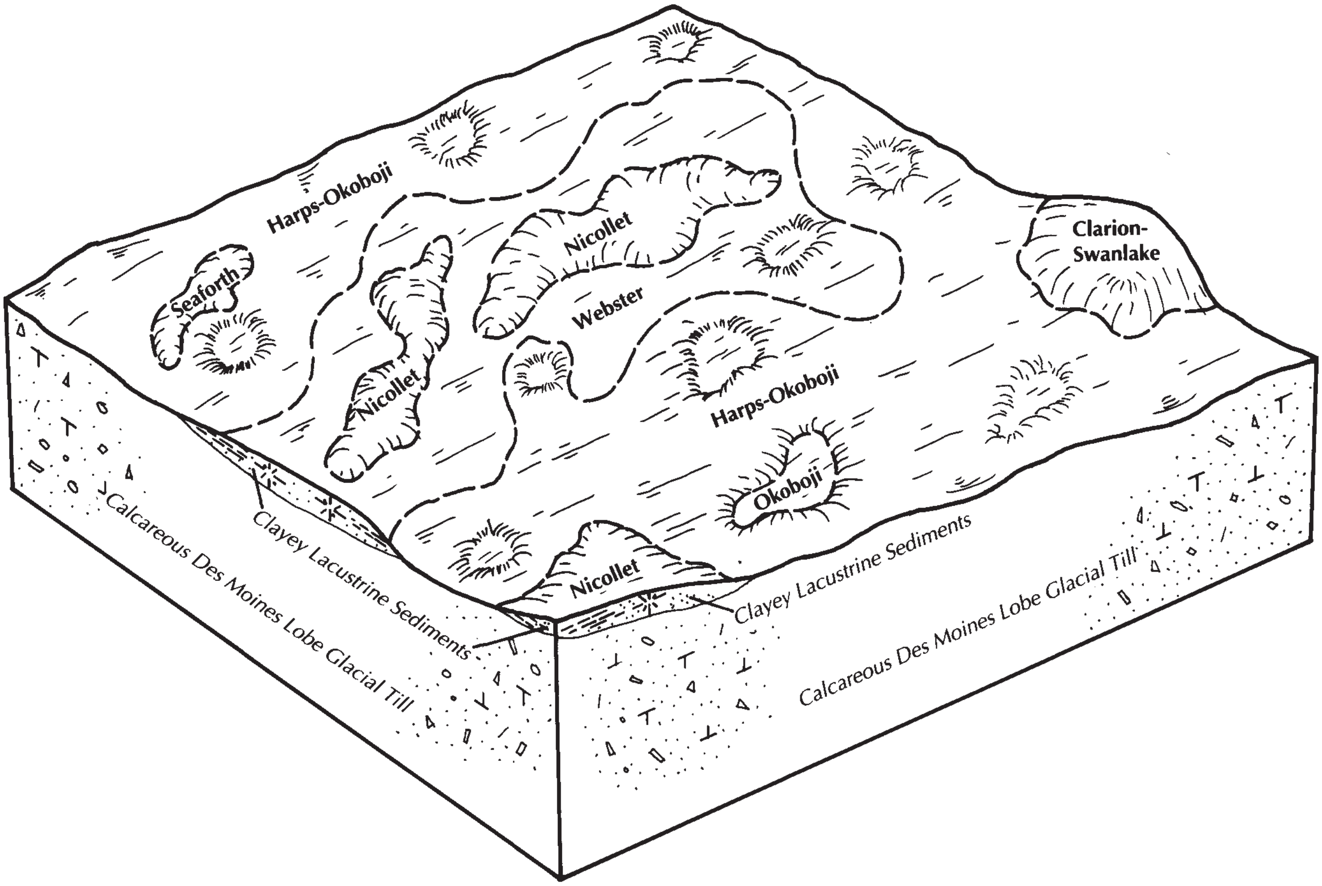
Harps-Okoboji
Seaforth
Nicollet
Webster
Nicollet
Clarion-
Swanlake
Harps-Okoboji
Okoboji
Nicollet
Calcareous Des Moines Lobe Glacial Till
Clayey Lacustrine Sediments
Clayey Lacustrine Sediments
Calcareous Des Moines Lobe Glacial Till

Figure 2.—Typical pattern of soils and parent material in the Harps-Nicollet-Webster association.

5. Swedegrove-Grovecity-Lundlake Association

Setting

Landform: Moraines
Position on the landform: Rims of depressions, summits on low hills, and depressions
Slope range: 0 to 3 percent

Composition

Percent of survey area: 3
Extent of components in the association:
Swedegrove and similar soils—28 percent
Grovecity and similar soils—27 percent
Lundlake and similar soils—20 percent
Soils of minor extent—25 percent

Soil Properties and Qualities

Swedegrove

Drainage class: Poorly drained
Parent material: Till
Surface texture: Loam

Grovecity

Drainage class: Moderately well drained
Parent material: Till
Surface texture: Loam

Lundlake

Drainage class: Very poorly drained
Parent material: Till
Surface texture: Silty clay loam

Minor Soils

- Wadenill and similar soils
- Sunburg and similar soils
- Uniongrove and similar soils
- Klossner and similar soils

6. Wadenill-Swedegrove-Muskego Association

Setting

Landform: Moraines

Position on the landform: Backslopes and summits, rims of depressions, and large depressions
Slope range: 0 to 12 percent

Composition

Percent of survey area: 10
Extent of components in the association:
Wadenill and similar soils—25 percent
Swedegrove and similar soils—20 percent
Muskego and similar soils—13 percent
Soils of minor extent—42 percent

Soil Properties and Qualities

Wadenill

Drainage class: Well drained
Parent material: Till
Surface texture: Loam

Swedegrove

Drainage class: Poorly drained
Parent material: Till
Surface texture: Loam

Muskego

Drainage class: Very poorly drained
Parent material: Organic materials and coprogenous earth
Surface texture: Muck

Minor Soils

- Sunburg and similar soils
- Grovecity and similar soils
- Uniongrove and similar soils

7. Koronis-Forestcity-Houghton Association

Setting

Landform: Moraines
Position on the landform: Backslopes and summits, footslopes and narrow drainageways, and large depressions
Slope range: 0 to 12 percent

Composition

Percent of survey area: 19
Extent of components in the association (fig. 3):
Koronis and similar soils—32 percent
Forestcity and similar soils—21 percent
Houghton and similar soils—11 percent
Soils of minor extent—36 percent

Soil Properties and Qualities

Koronis

Drainage class: Well drained
Parent material: Till
Surface texture: Loam

Forestcity

Drainage class: Poorly drained
Parent material: Local alluvium over till
Surface texture: Fine sandy loam

Houghton

Drainage class: Very poorly drained
Parent material: Organic materials
Surface texture: Muck

Minor Soils

- Lundlake and similar soils
- Marcellon and similar soils
- Shorewood and similar soils
- Sparta and similar soils

8. Koronis-Houghton-Forestcity Association

Setting

Landform: Moraines
Position on the landform: Backslopes and summits, large depressions, and footslopes and narrow drainageways
Slope range: 0 to 18 percent

Composition

Percent of survey area: 4
Extent of components in the association:
Koronis and similar soils—49 percent
Houghton and similar soils—14 percent
Forestcity and similar soils—14 percent
Soils of minor extent—23 percent

Soil Properties and Qualities

Koronis

Drainage class: Well drained
Parent material: Till
Surface texture: Sandy loam

Houghton

Drainage class: Very poorly drained
Parent material: Organic materials
Surface texture: Muck

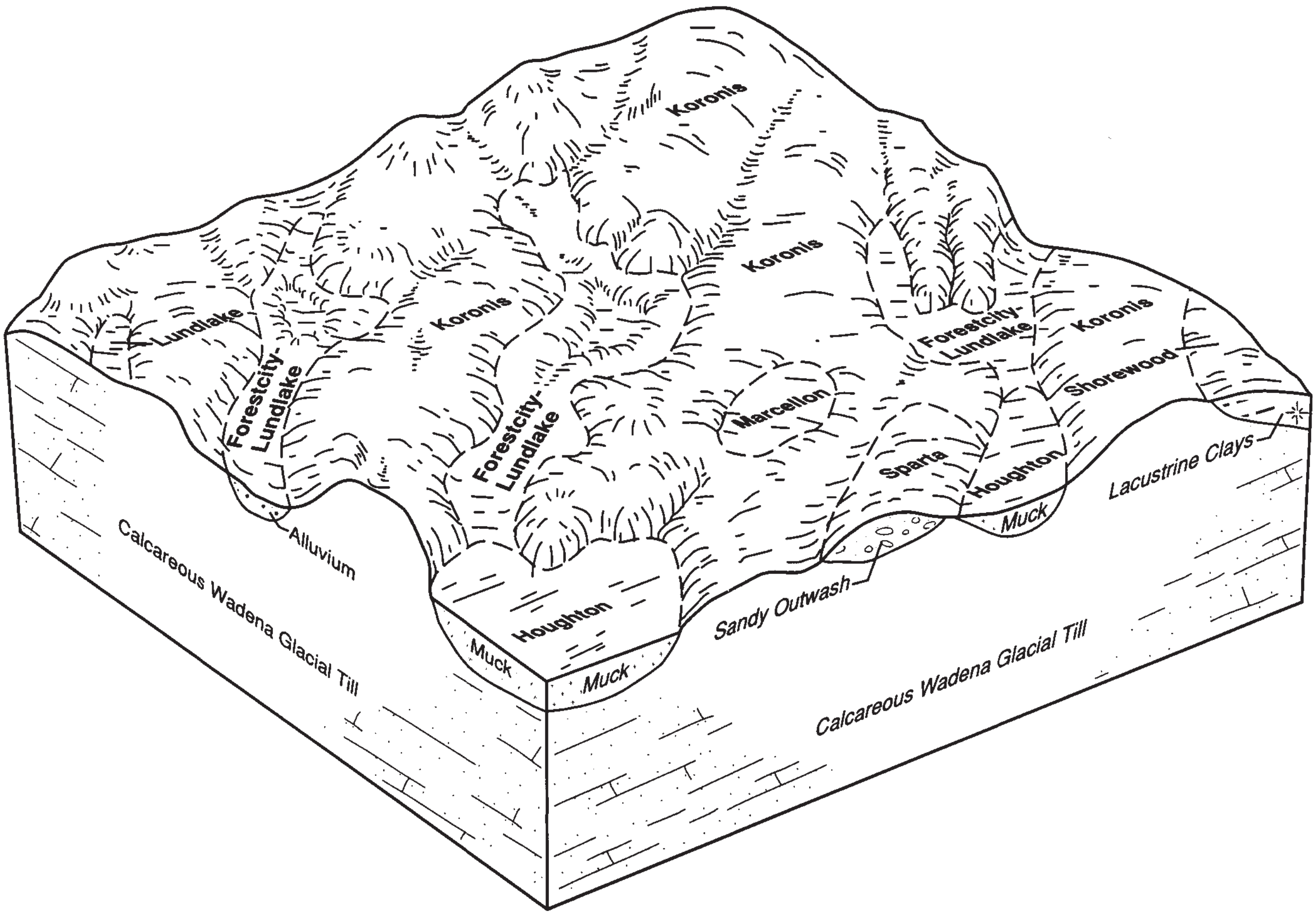
Koronis
Koronis
Koronis
Koronis
Lundlake
Forestcity-Lundlake
Forestcity-Lundlake
Forestcity-Lundlake
Shorewood
Marcellon
Sparta
Houghton
Houghton
Muck
Muck
Muck
Lacustrine Clays
Alluvium
Sandy Outwash
Calcareous Wadena Glacial Till
Calcareous Wadena Glacial Till

Figure 3.—Typical pattern of soils and parent material in the Koronis-Forestcity-Houghton association.

Forestcity

Drainage class: Poorly drained
Parent material: Local alluvium over till
Surface texture: Fine sandy loam

Minor Soils

- Okoboji and similar soils
- Klossner and similar soils
- Muskego and similar soils
- Marcellon and similar soils

Nearly Level to Moderately Steep, Silty, Clayey, and Loamy Soils That Formed in Till; on Moraines

9. Cosmos-Kandiyohi-Corvuso Association

Setting

Landform: Moraines
Position on the landform: Drainageways and flats, backslopes and low summits, and rims of depressions
Slope range: 0 to 5 percent

Composition

Percent of survey area: 3
Extent of components in the association (fig. 4):
Cosmos and similar soils—30 percent
Kandiyohi and similar soils—24 percent
Corvuso and similar soils—18 percent
Soils of minor extent—28 percent

Soil Properties and Qualities

Cosmos

Drainage class: Poorly drained
Parent material: Glaciolacustrine deposits over till
Surface texture: Silty clay

Kandiyohi

Drainage class: Somewhat poorly drained

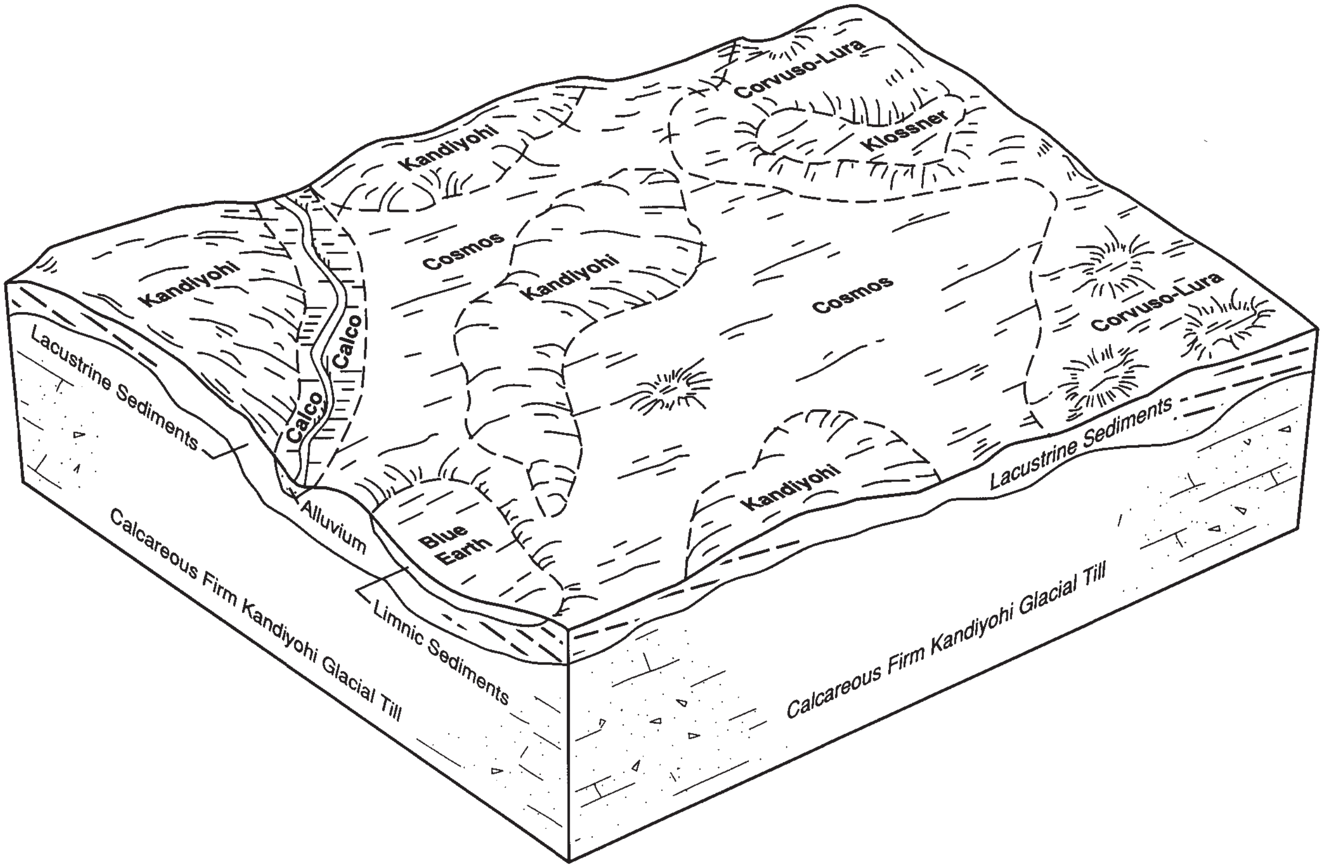
Corvuso-Lura
Klossner
Kandiyohi
Cosmos
Kandiyohi
Kandiyohi
Calco
Calco
Calco
Cosmos
Corvuso-Lura
Lacustrine Sediments
Alluvium
Blue Earth
Kandiyohi
Lacustrine Sediments
Limnic Sediments
Calcareous Firm Kandiyohi Glacial Till
Calcareous Firm Kandiyohi Glacial Till

Figure 4.—Typical pattern of soils and parent material in the Cosmos-Kandiyohi-Corvuso association.

Parent material: Glaciolacustrine deposits over till
Surface texture: Clay

Corvuso

Drainage class: Poorly drained
Parent material: Glaciolacustrine deposits over till
Surface texture: Clay loam

Minor Soils

- Lura and similar soils
- Klossner and similar soils
- Blue Earth and similar soils
- Calco and similar soils

10. Cosmos-Strout-Kandiyohi Association

Setting

Landform: Moraines
Position on the landform: Drainageways and flats; backslopes and summits
Slope range: 0 to 6 percent

Composition

Percent of survey area: 6
Extent of components in the association:
Cosmos and similar soils—33 percent
Strout and similar soils—25 percent
Kandiyohi and similar soils—15 percent
Soils of minor extent—27 percent

Soil Properties and Qualities

Cosmos

Drainage class: Poorly drained
Parent material: Glaciolacustrine deposits over till
Surface texture: Silty clay

Strout

Drainage class: Moderately well drained
Parent material: Till
Surface texture: Clay

Kandiyohi

Drainage class: Somewhat poorly drained
Parent material: Glaciolacustrine deposits over till

Surface texture: Clay

Minor Soils

- Lura and similar soils
- Muskego and similar soils
- Newlondon and similar soils

11. Danielson-Newlondon-Strout Association

Setting

Landform: Moraines
Position on the landform: Footslopes and narrow drainageways, shoulders and backslopes, and summits
Slope range: 1 to 18 percent

Composition

Percent of survey area: 3
Extent of components in the association:
Danielson and similar soils—27 percent
Newlondon and similar soils—25 percent
Strout and similar soils—24 percent
Soils of minor extent—24 percent

Soil Properties and Qualities

Danielson

Drainage class: Poorly drained
Parent material: Colluvium over till
Surface texture: Clay loam

Newlondon

Drainage class: Moderately well drained
Parent material: Till
Surface texture: Clay loam

Strout

Drainage class: Moderately well drained
Parent material: Till
Surface texture: Clay

Minor Soils

- Klossner and similar soils
- Lura and similar soils
- Blue Earth and similar soils
- Muskego and similar soils

Nearly Level to Strongly Sloping, Silty Soils That Formed in Lacustrine Deposits; on Lake Plains

12. Collinwood-Waldorf-Shorewood Association

Setting

Landform: Lake plains
Position on the landform: Backslopes and low summits; drainageways and flats
Slope range: 0 to 6 percent

Composition

Percent of survey area: 2
Extent of components in the association:
Collinwood and similar soils—43 percent
Waldorf and similar soils—25 percent
Shorewood and similar soils—22 percent
Soils of minor extent—10 percent

Soil Properties and Qualities

Collinwood

Drainage class: Moderately well drained
Parent material: Lacustrine deposits
Surface texture: Silty clay loam

Waldorf

Drainage class: Poorly drained
Parent material: Lacustrine deposits
Surface texture: Silty clay loam

Shorewood

Drainage class: Somewhat poorly drained and moderately well drained
Parent material: Lacustrine deposits
Surface texture: Silty clay loam

Minor Soils

- Klossner and similar soils
- Okoboji and similar soils
- Truman and similar soils

13. Madelia-Truman-Kingston Association

Setting

Landform: Lake plains
Position on the landform: Flats and drainageways, backslopes and summits, and rises

Slope range: 0 to 12 percent

Composition

Percent of survey area: 3
Extent of components in the association (fig. 5):
Madelia and similar soils—31 percent
Truman and similar soils—19 percent
Kingston and similar soils—17 percent
Soils of minor extent—33 percent

Soil Properties and Qualities

Madelia

Drainage class: Poorly drained
Parent material: Lacustrine deposits
Surface texture: Silty clay loam

Truman

Drainage class: Well drained
Parent material: Lacustrine deposits
Surface texture: Silt loam

Kingston

Drainage class: Moderately well drained
Parent material: Lacustrine deposits
Surface texture: Silty clay loam

Minor Soils

- Okoboji and similar soils
- Darfur and similar soils
- Gardencity and similar soils
- Bold and similar soils

Nearly Level to Hilly, Loamy and Sandy Soils; on Outwash Plains, Terraces, and Deltas

14. Sparta-Darfur-Litchfield Association

Setting

Landform: Outwash plains, terraces, and deltas
Position on the landform: Summits and backslopes, drainageways, and flats and slight rises

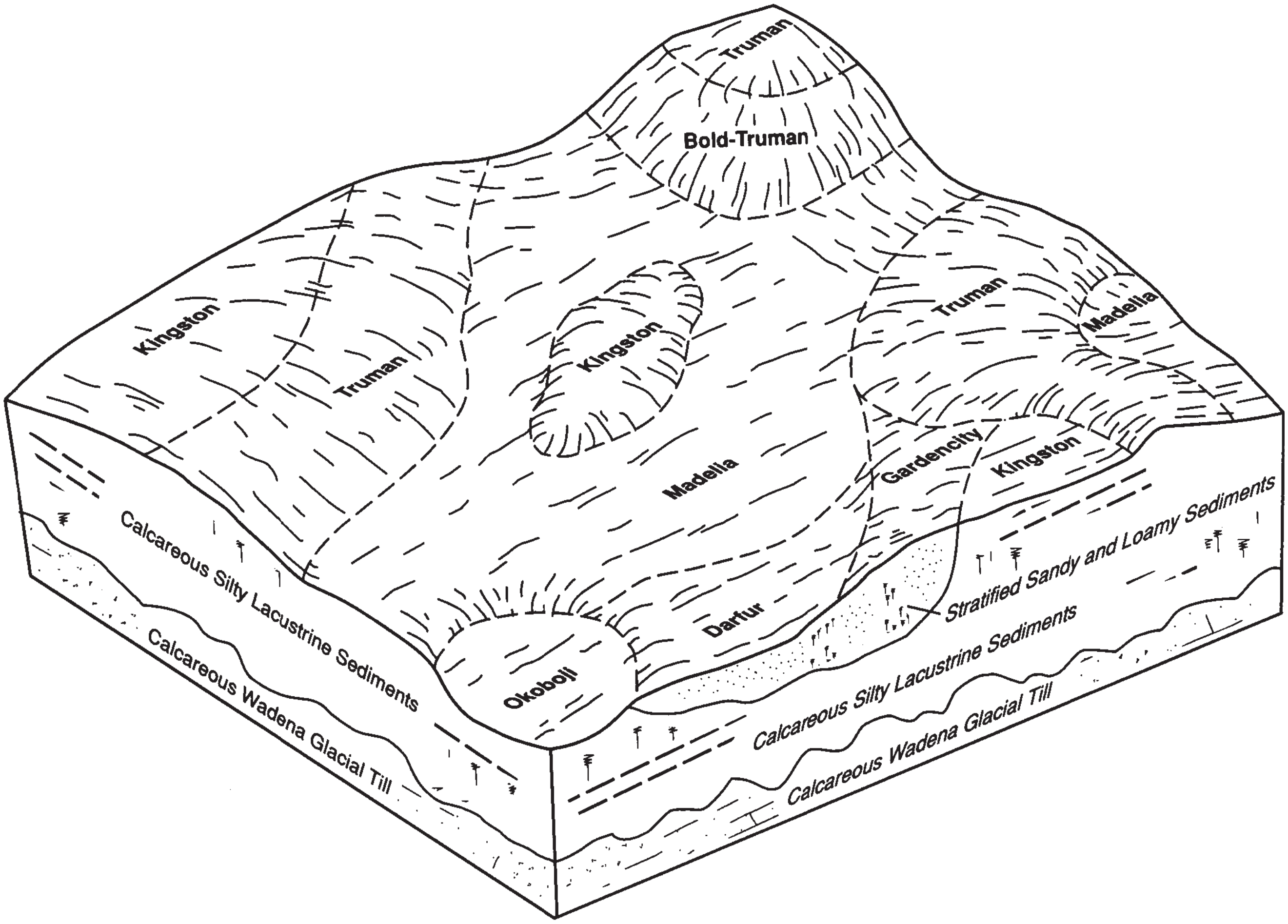
Truman
Bold-Truman
Kingston
Truman
Kingston
Truman
Madelia
Madelia
Gardencity
Kingston
Darfur
Okoboji
Calcareous Silty Lacustrine Sediments
Calcareous Wadena Glacial Till
Stratified Sandy and Loamy Sediments
Calcareous Silty Lacustrine Sediments
Calcareous Wadena Glacial Till

Figure 5.—Typical pattern of soils and parent material in the Madelia-Truman-Kingston association.

Slope range: 0 to 6 percent

Composition

Percent of survey area: 4
Extent of components in the association:
Sparta and similar soils—41 percent
Darfur and similar soils—28 percent
Litchfield and similar soils—15 percent
Soils of minor extent—16 percent

Soil Properties and Qualities

Sparta

Drainage class: Excessively drained
Parent material: Glacial outwash
Surface texture: Loamy sand

Darfur

Drainage class: Poorly drained
Parent material: Glacial outwash
Surface texture: Loam

Litchfield

Drainage class: Moderately well drained
Parent material: Glacial outwash
Surface texture: Loamy fine sand

Minor Soils

- Klossner and similar soils
- Darfur and similar soils
- Cylinder and similar soils
- Gardencity and similar soils

15. Kanaranzi-Estherville-Biscay Association

Setting

Landform: Outwash plains and terraces
Position on the landform: Slight rises, backslopes, flats, and drainageways
Slope range: 0 to 6 percent

Composition

Percent of survey area: 5
Extent of components in the association (fig. 6):
Kanaranzi and similar soils—38 percent
Estherville and similar soils—17 percent
Biscay and similar soils—17 percent
Soils of minor extent—28 percent

Soil Properties and Qualities

Kanaranzi

Drainage class: Well drained
Parent material: Glacial outwash
Surface texture: Loam

Estherville

Drainage class: Somewhat excessively drained
Parent material: Glacial outwash
Surface texture: Sandy loam

Biscay

Drainage class: Poorly drained
Parent material: Glacial outwash
Surface texture: Loam

Minor Soils

- Klossner and similar soils
- Dassel and similar soils
- Cylinder and similar soils
- Wadena and similar soils
- Hawick and similar soils

16. Fieldon-Litchfield-Dassel Association

Setting

Landform: Outwash plains, terraces, and deltas
Position on the landform: Rims of depressions, flats, and shallow depressions
Slope range: 0 to 2 percent

Composition

Percent of survey area: 5
Extent of components in the association (fig. 7):
Fieldon and similar soils—26 percent
Litchfield and similar soils—16 percent
Dassel and similar soils—15 percent
Soils of minor extent—43 percent

Soil Properties and Qualities

Fieldon

Drainage class: Poorly drained
Parent material: Glaciolacustrine deposits or glacial outwash
Surface texture: Loam

Litchfield

Drainage class: Moderately well drained
Parent material: Glacial outwash
Surface texture: Loamy fine sand

Dassel

Drainage class: Very poorly drained
Parent material: Glaciolacustrine deposits or glacial outwash

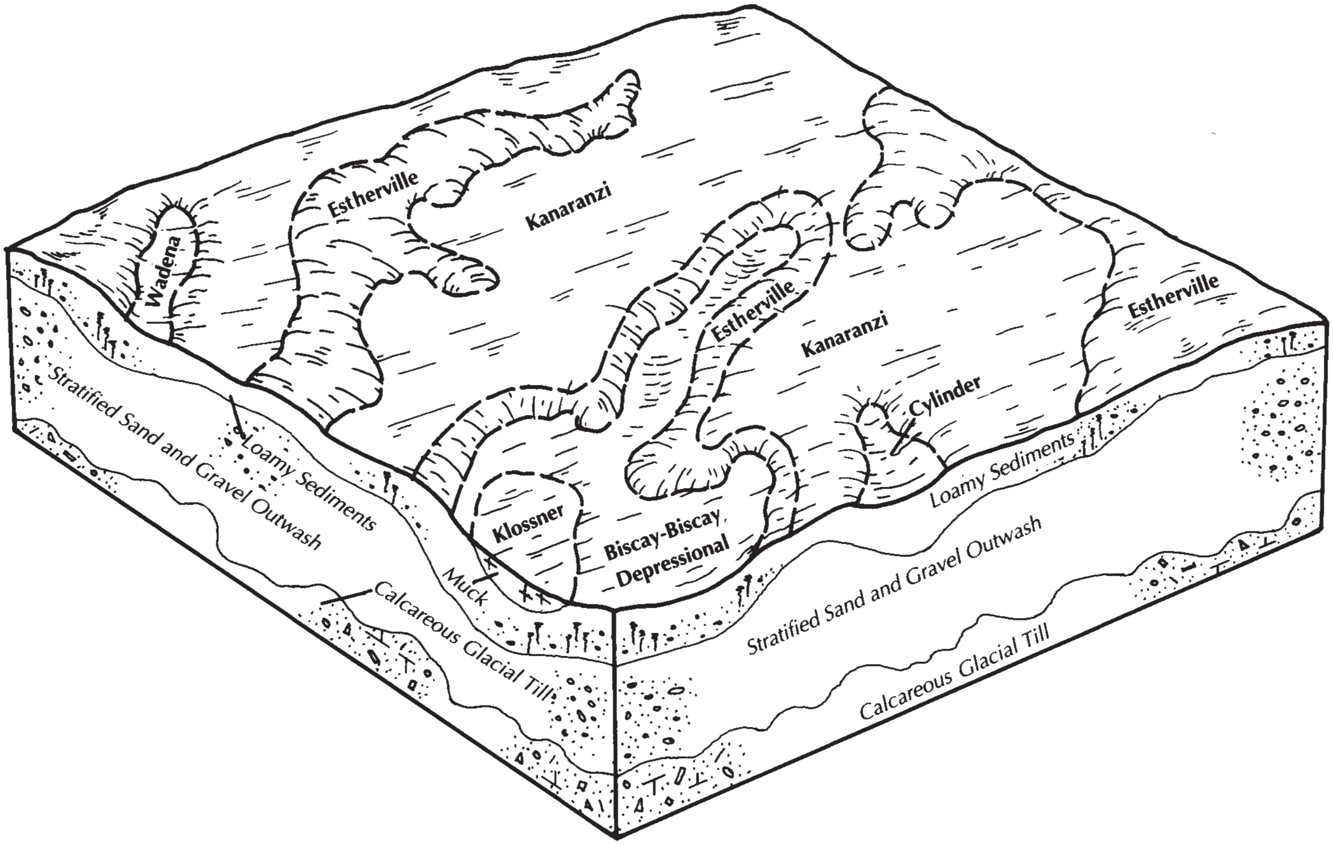
Wadena
Estherville
Kanaranzi
Estherville
Kanaranzi
Estherville
Cylinder
Klossner
Biscay-Biscay Depressional
Stratified Sand and Gravel Outwash
Loamy Sediments
Muck
Calcareous Glacial Till
Loamy Sediments
Stratified Sand and Gravel Outwash
Calcareous Glacial Till

Figure 6.—Typical pattern of soils and parent material in the Kanaranzi-Estherville-Biscay association.

Surface texture: Mucky fine sandy loam

Minor Soils

- Sparta and similar soils
- Dickman and similar soils
- Minneopa and similar soils
- Biscay and similar soils
- Darfur and similar soils
- Granby and similar soils
- Klossner and similar soils

17. Hawick-Estherville Association

Setting

Landform: Outwash plains and terraces
Position on the landform: Shoulders, backslopes, and summits
Slope range: 0 to 18 percent

Composition

Percent of survey area: 1
Extent of components in the association:
Hawick and similar soils—48 percent
Estherville and similar soils—37 percent
Soils of minor extent—15 percent

Soil Properties and Qualities

Hawick

Drainage class: Excessively drained
Parent material: Glacial outwash
Surface texture: Sandy loam

Estherville

Drainage class: Somewhat excessively drained
Parent material: Glacial outwash
Surface texture: Sandy loam

Minor Soils

- Muskego and similar soils
- Cylinder and similar soils
- Sparta and similar soils

Soils on Flood Plains and Terraces

18. Cohoctah-Muskego-Estherville Association

Setting

Landform: Flood plains and terraces
Position on the landform: Flats, depressions, and backslopes and summits
Slope range: 0 to 6 percent

Composition

Percent of survey area: 3
Extent of components in the association:
  Cohoctah and similar soils—47 percent
  Muskego and similar soils—16 percent
  Estherville and similar soils—13 percent
  Soils of minor extent—24 percent

Soil Properties and Qualities

Cohoctah

Drainage class: Poorly drained
Parent material: Alluvium
Surface texture: Loam

Muskego

Drainage class: Very poorly drained
Parent material: Organic materials and coprogenous earth
Surface texture: Muck

Estherville

Drainage class: Somewhat excessively drained
Parent material: Glacial outwash
Surface texture: Sandy loam

Minor Soils

- Zook and similar soils
- Sparta and similar soils

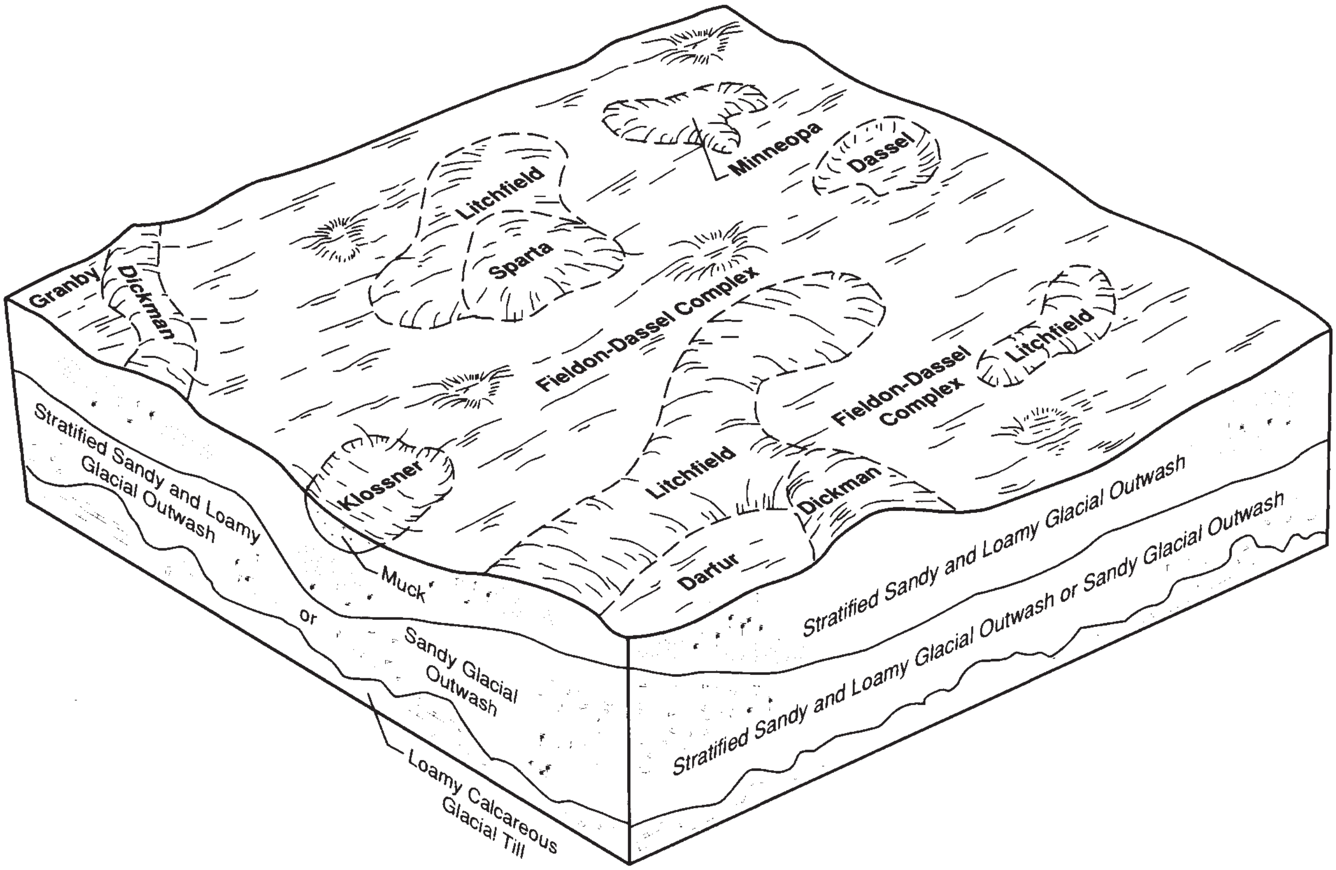
Granby
Dickman
Litchfield
Sparta
Minneopa
Dassel
Fieldon-Dassel Complex
Fieldon-Dassel Complex
Litchfield
Klossner
Litchfield
Dickman
Darfur
Stratified Sandy and Loamy Glacial Outwash
Muck
or
Sandy Glacial Outwash
Loamy Calcareous Glacial Till
Stratified Sandy and Loamy Glacial Outwash
Stratified Sandy and Loamy Glacial Outwash or Sandy Glacial Outwash

Figure 7.—Typical pattern of soils and parent material in the Fieldon-Litchfield-Dassel association.

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Formation and Classification of the Soils

This section relates the soils in the survey area to the major factors of soil formation and describes the system of soil classification.

Formation of the Soils

Soils form through processes generated by the interaction of five factors—parent material, climate, plant and animal life, landscape setting, and time. The interaction of these factors generates complex chemical, physical, and biological processes, many of which are mutually dependent. As a result of the multitude of processes in effect over time, definitive layers or horizons form in the soil. These layers are described under the heading "Processes of Soil Formation."

Parent Material

Parent material is the physical medium within which the soil develops. Parent material largely determines important physical properties of the soil, such as the ability to store water for plants and the ability to transmit water. Parent material also largely determines the ability to supply important plant nutrients, such as calcium, phosphorus, and potassium. These physical and chemical properties are related, to a large extent, to the proportion of sand, silt, and clay in the parent material. Soils that formed in parent materials high in silt, for example, have a high capacity to store water for plants. Soils that formed in parent materials high in clay and silt have a high capacity to store nutrients for plants. Soils that formed in parent materials high in sand have a low capacity to store both water and nutrients.

The soils of Meeker County had their beginnings in water and ice. Glacial ice from northern and western sources have covered the survey area many times. The glacial deposits mantle the underlying shale and granitic bedrock to a depth of 200 to 400 feet. As the glaciers melted, they left behind a variety of deposits. These include glacial till, glaciolacustrine deposits, and glacial outwash (see map, Surface Geology).

Glacial till is the most common parent material in the county. Glacial till is a term used by geologists to describe sediment that was deposited by the melting of glacial ice. It is an unsorted mixture of clay, silt, sand, gravel, cobbles, and boulders. The presence of cobbles and stones is one of the main features of glacial till. Deposits of glacial till are referred to as moraines.

Much of the history of early glaciations is obscure. The more recent glaciations took place between 10,000 and 75,000 years ago, a glacial period during which most of Minnesota and nearby states and all of Meeker County were covered a number of times by glacial ice. Glaciations that took place during this time are collectively known as the Late Wisconsin glaciation.

Four kinds of glacial till are recognized in Meeker County, but only three have provided parent material for the formation of soil.

A brownish, loamy to gravelly sediment is exposed near the surface of a number of gravel pits in the northern part of the county. The age of this sediment, mostly glacial outwash, is unclear. The sediment appears to have originated in the northeastern part of the state because the deposits have coarse fragments derived from granitic rocks that occur in that region. Soils that formed in this brownish sediment are in just a few areas in the county.

The soils in the county that formed in glacial till formed in three different glacial deposits. Soil scientists and geologists recognize some subtle color differences between the three tills, but in general the tills have an olive brown, or buff, color where they are exposed on cut banks on slopes. The first of these glacial tills was deposited by ice that came from the north and west and buried older glacial deposits. This glacier, the age of which is uncertain, deposited a loamy to clayey till that is rich in shale. The glacier that deposited this shaly till probably covered the entire county, but it is buried in most places by glacial tills that arrived later. It is known by geologists as Kandiyohi till and provided the parent material for most of the soils in the southwestern part of the county. Most of the soils in associations 10 and 11 (described under the heading "General Soil Map Units") formed in Kandiyohi till. Corvuso, Cosmos, Kandiyohi, Newlondon, and Strout soils are examples.

The shale-rich Kandiyohi till is covered in most of the county by glacial till that has as its main features a high content of sand and many cobbles and stones. This glacial till is believed to have been deposited sometime before 34,000 years ago (Ojakangas and Matsch, 1982). It came from the north and is believed to blanket all of the county, except for areas of the Kandiyohi till in the west-central part of the county. This sandy loam deposit is known by geologists as Granite Falls till, a deposit of the Wadena lobe of the late Wisconsin glaciation. Most of the soils in associations 5, 6, 7, and 8 formed in Granite Falls till. Crowriver, Forestcity, Grovecity, Koronis, Lundlake, Sunburg, Swedegrove, Uniongrove, and Wadenill soils are examples.

The last glaciation to enter the survey area deposited a loamy sediment known as New Ulm till. This till is intermediate between Kandiyohi and Wadena till in content of clay, sand, and rock. The glacier that brought this sediment is known as the Des Moines lobe of the late Wisconsin glaciation. It is believed to have arrived in the area about 14,000 years ago. The Des Moines lobe arrived from the northwest. It entered the western part of the county in Cosmos and Danielson Townships and continued southward into Renville County, where a sublobe (known as the Grantsburg) began to flow northeastward and re-entered the county from the south in Cedar Mills Township. Meeker County lies on the western edge of the Grantsburg lobe. The Des Moines lobe eventually covered all of east-central Minnesota. The Grantsburg sublobe covered the southeastern part of the county (Cedar Mills, Collinwood, and Ellsworth Townships and the eastern part of Dassel and Kingston Townships). East of Kingston, near the Wright County line, the ice crossed the North Fork of the Crow River, which was an outlet for glacial meltwater flowing eastward to the Mississippi River. The ice continued to flow about a mile northward. At that point the ice swung eastward into Wright County. Most of the soils in associations 1, 2, 3, and 4 formed in New Ulm till. Canisteo, Clarion, Cordova, Glencoe, Harps, Le Sueur, Lester, Nicollet, Rolfe, Storden, and Webster soils are examples.

The melting of glaciers produced large amounts of meltwater. The volume of meltwater was enormous, and large amounts of glacial sediment washed out of the melting glacial ice. The ability to carry sediment is dependent upon the energy with which the water flows. Where the water flows rapidly, a larger volume of sediment and the larger particles can be carried. Meltwater carried large amounts of sediment away from the glacial ice front. Much of the smaller silt and clay particles were transported to streams and rivers and carried far downstream. In places the silts and clays were carried to lakes and ponds.

Coarse textured sediment deposited by glacial meltwater is known as glacial outwash. Only large sand and gravel particles were heavy enough to resist the high energy of the large amounts of water generated by the melting glaciers. Glacial outwash that may have been generated by the glaciers that deposited the Kandiyohi and Granite Falls till is buried by deposits of New Ulm till or other sediments.

Meltwater from the Des Moines lobe carved shallow channels eastward to the Mississippi River. A large outwash plain, referred to as the Darwin sand plain, was deposited near the center of the county—the northern part of Ellsworth and Greenleaf Townships and the southern part of Darwin and Litchfield Townships—by this meltwater. The coarser material, sand and gravel, was laid down in alternating layers at the front of the ice sheet. This coarse textured glacial outwash lies mostly south of U.S. Highway 12 between Darwin and Litchfield. It provides a source of sand and gravel (fig. 8). North of Highway 12 the soils are mostly underlain by sand. During the last stages of deposition, a thin discontinuous mantle of loamy sediment, commonly 1 to 3 feet thick, was laid on top of the coarse sediment. Most of the soils in associations 14, 15, and 16 formed in this outwash sediment. Biscay, Chelsea, Dickman, Estherville, Granby, Hawick, Kanaranzi, Litchfield, Mayer, Minneopa, and Sparta soils formed in glacial outwash.

For some time after the Des Moines glaciation crossed the glacial Crow River, deposits of glacial till formed an effective dam that blocked the eastward flow of meltwater and sediment. In the northeastern part of the county, meltwater seeking an outlet spread across the lower lying areas and eventually formed a large glacial lake with many arms and bays. This glacial lake occupied large areas in Forest City, Harvey, and Kingston Townships. The great energy of the glacial meltwater was absorbed in the glacial lake. In the quiet water of the glacial lake the meltwaters were unable to hold their load of sediment in suspension; even small particles, such as clay and silt, did not remain in suspension but settled to the bottom of the lake. The sediments deposited in glacial lakes are called glaciolacustrine deposits. These deposits in Meeker County are estimated to be as much as 25 feet thick in places. Clays settled in the deeper and quieter parts of the lake. Where the lake was more shallow or there was some movement of water, dominantly silt-sized particles settled to the floor of the lake. In places where streams entered the lake, the lighter weight clays were carried to the deeper parts of

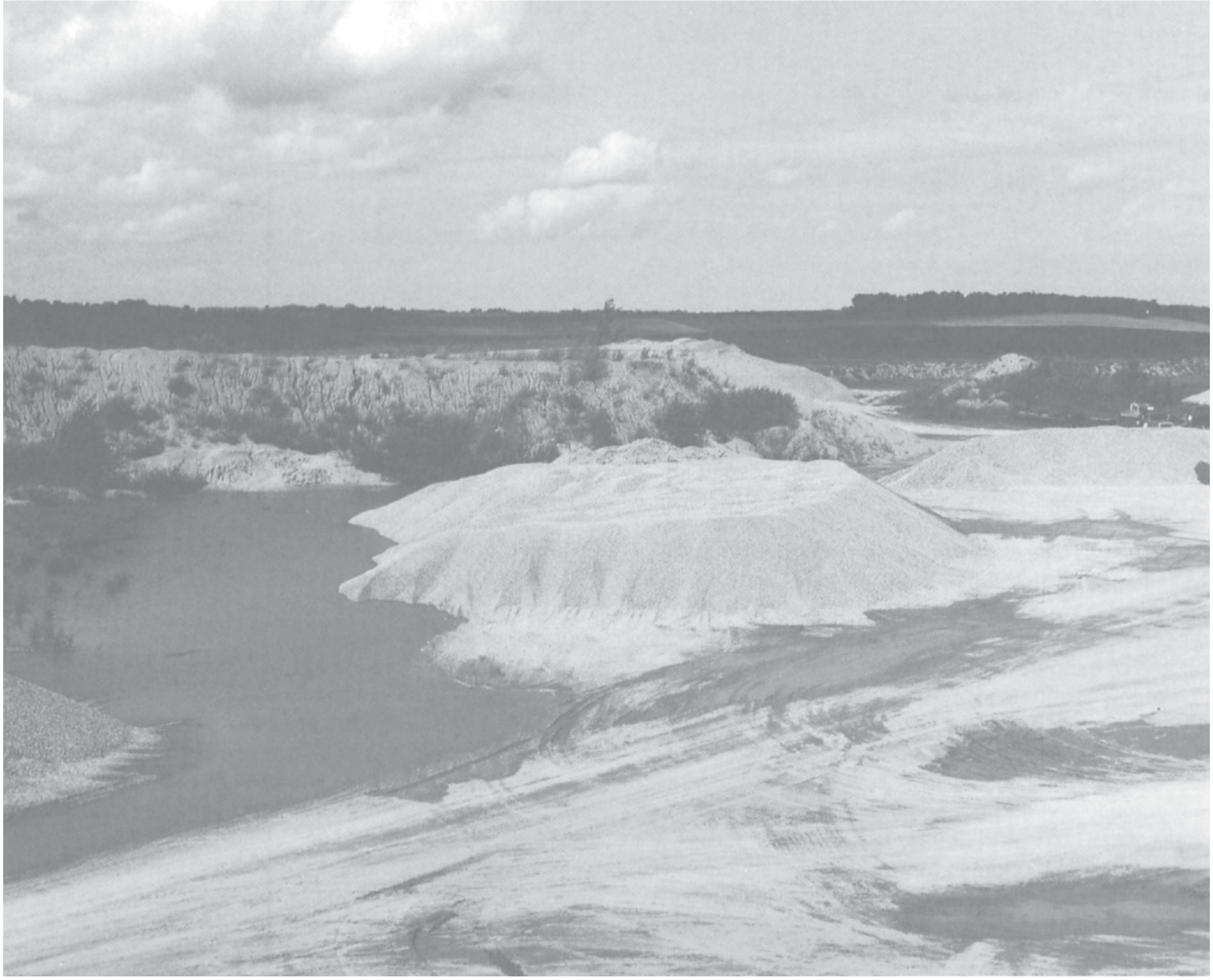

Figure 8.—A gravel and sand pit in an area of Pits, gravel-Udipsamments complex.

the lake. In the shallower parts of the lakes and near the mouths of the former streams, beds of sandy, silty, and loamy sediment were deposited in alternating strata. Most of the soils in associations 12 and 13 formed in lacustrine sediments. Collinwood, Okoboji, Shorewood, Spicer, and Waldorf soils formed in clay lacustrine deposits. Bold, Kingston, and Madelia soils formed in silty lacustrine deposits. Gardencity, Darfur, and Fieldon soils formed in the stratified deposits.

At about the time the large glacial lake was forming in Forest City, Harvey, and Kingston Townships, a shallow lake appears to have formed in the southwestern part of the county. This lake was possibly created as a result of the Grantsburg sublobe flowing northeastward across Cedar Mills Township and forming a natural dam blocking the drainage of meltwater to the east. The lacustrine sediments deposited in the shallow lake were mostly clay and silt. The nearby clayey till was a good source of both. The sediments are mostly less than 5 feet thick. Most of the soils in association 9 formed in these thin lacustrine sediments and in the underlying clayey till. Lura soils formed in these lacustrine sediments. In many places these sediments form the upper part of the Corvuso, Cosmos, and Kandiyohi soils.

Ice-walled lakes and collapsed outwash plains are other forms of glacial deposits in Meeker County. These features occur in the eastern part of the county on the edge of the Grantsburg glacier. In this area, glacial lakes formed on the surface of stagnant ice.

Stagnant ice is a term used to describe a condition where ice ceases to flow and the cessation of flow is followed by slow melting of the sediment-laden ice. Meltwater laden with sediment held in suspension flowed into lows in the ice-streams, shallow lakes, and ponds.

The streams carried the lighter weight silts and clays to low areas on the landscape (ponds and shallow lakes) or carried them away from the ice field. The heavier particles, such as sand and gravel, mostly remained near the stream channels, but some of these were carried to lakes and ponds also.

As the glacier melted, the ice forming the beds of streams and the walls of ponds and lakes collapsed onto and in places became incorporated into the underlying ice and sediment. As a result, many of the former streams, lakes, and ponds are no longer in evidence; the postglacial landscape is made up of a disordered assortment of knolls, swales, and closed depressions. Those meltwater sediments that survived the collapse of the glacier are perched at the highest elevations on the local landscape. Examples of ice-walled lakes and ponds and streams on the former surface of the glacial ice are throughout the eastern part of the county. Shorewood soils formed in clayey sediment deposited in the lakes and ponds. They are in areas characterized by smooth-sided knolls and hills. Estherville and Hawick soils formed in the sandy and gravelly sediment deposited near streams and in some of the lakes and ponds. They are in areas characterized by undulating to rolling landscapes containing scattered depressions. The soils in association 17 formed in these collapsed sandy and gravelly sediments.

The final stage in the deposition of parent material in Meeker County was the deposition of alluvium along flood plains. Most of the landscape development of stream valleys took place during the last stages of glacial melting. Since the melting of the last glacier about 10,000 years ago, there has been little alteration of the topography. Streams are narrow and have cut but a few tens of feet below the surrounding landscape. During the many centuries since the retreat of the glaciers, the North Fork of the Crow River has meandered across its flood plain. The accompanying shifting pattern of sedimentation resulted in highly stratified alluvium. Where the water flow was slower, the finer particles fell to the valley floor. Backwaters and channels received a thin layer of silty and clayey sediment as much as 5 feet in thickness. The sediments nearer to the stream are more sandy. Most of the sediments deposited on the present-day flood plain have as their source the nearby constantly eroding river banks. The present Crow River drainage system is oversized for the amount of water it now carries. Many of the soils in association 18 formed in these recently deposited alluvial sediments. Cohoctah soils formed in sandy and loamy deposits nearest the river. Calco and Zook soils formed in silty and clayey deposits in backwater areas farther from the stream.

Climate

Climate influences soil formation by providing moisture and heat necessary for the weathering of parent material and for the growth of organisms. Water dissolves soluble materials and transports them along with organic material to other parts of the soil. Temperature and water affect the rate of chemical and physical reactions. These reactions are slower at freezing than at a higher temperature. Moisture and temperature affect the kinds of plants that grow on the soil. They also are important to animal life, which helps to convert dead vegetation to humus and plant nutrients. Further, the rate at which organic matter decays or accumulates in the soil is influenced by moisture and temperature along with vegetation. Because of the cold winters, soil-forming factors are mostly inactive in Meeker County for about 5 months of the year.

Climate is nearly uniform throughout the county, but some local differences in the soils are caused by parent material and landscape setting.

Topography

Topography, or landscape setting, refers to the location of the soil on the landscape. Landscape setting affects soil formation by its influence on the amount of runoff (or run-on) that will determine, along with infiltration rates and permeability of the parent material, the amount of water that enters or passes through the soil. Storden, Clarion, Nicollet, Webster, and Glencoe soils formed in the same parent material—New Ulm till. Differences in the characteristics of these soils are mostly the result of processes related to landscape position. Landscape position affects the amount of rainfall and snowmelt that runs off the soil and the relative amount that enters the soil. Storden soils, which are on the most convex parts of side slopes on knolls, have a high runoff rate; that is, a relatively small amount of rainfall and snowmelt is able to enter these soils. Clarion soils, which are on the less convex parts of knolls and hills, have a lower runoff rate. Thus more water infiltrates the soil and percolates through it. Nicollet soils are on the nearly level, slightly convex summits of hills or slight rises in broad nearly level areas. These soils have a lower runoff rate than the Clarion soils and thus have a higher rate of water infiltration. Webster soils, in nearly level, plane or slightly concave positions, are subject to only a small amount of runoff and thus have a high rate of water infiltration. In most years so much water enters the Webster soils that they commonly become saturated for parts of the growing season. Glencoe soils are in closed depressions, the lowest areas on the landscape relative to adjacent soils. The Glencoe soils receive runoff from adjacent soils as well as rain that falls directly into the depressions. They are naturally saturated for nearly the entire growing season and have standing water on the surface for part of the season. Extreme differences in the amount of water in the soil affect the kinds and intensity of biological and chemical processes that operate in the soil. Different species of plants and different kinds of micro-organisms live where moisture is high than on dry sites where moisture is relatively low. Many tree species do not grow well where water is at or near the surface for much of the growing season. Reeds and sedges, however, require sites that have water at or near the surface during the same period.

Living Organisms

Plants and animals provide organic matter for the formation of soil humus. The stems, leaves, and roots of plants provide most of the organic matter. The species of plants and animals are influenced by the interacting factors of parent material, setting, and climate. Micro-organisms affected by these same factors transform organic matter into humus.

Plants influence soil chemistry. For example, soils that formed under prairie plants are less acid than those that formed under trees. Vegetation influences the rate at which clay is transferred from the surface layer to the subsoil. This rate influences the kinds of layers or horizons that form in a soil. Vegetation also influences the rate at which nutrients, such as calcium carbonate, are leached from the soil. Because of a greater loss of calcium carbonate, forest soils are relatively more acid than soils that formed in the same parent material under prairie vegetation.

Time

Time as a soil-forming factor is a measurement of how long the parent materials are exposed to the atmosphere. Soils in some parts of the world have been weathering for a million years or more. Soils that have been exposed to the soil-forming processes for a long time may have been leached of most of their nutrients. Also, their clay particles may have been altered to types of clay or other compounds that have little capacity to store nutrients for plants. Soil scientists consider these soils to be strongly weathered, or “old.” In Meeker County, the soils have been exposed to the soil-forming processes for a relatively short period of time. In addition, the cold winter temperatures in Meeker County stop many of the soil-forming processes. Because some processes are active for only about 7 months of the year, the rate at which the soils form is reduced. The soils in Meeker County have been subject to soil-forming processes for only 8,000 to 10,000 years. These soils are considered “young” soils because most of them still retain large amounts of nutrients for plants and have the capacity to store large amounts of nutrients. Relatively small amounts of fertilizer are needed to provide nutrients for the optimum growth of plants.

Processes of Soil Formation

Soils are the product of soil-forming processes that act upon parent material over a period of time. As a result of these processes, specific soils have distinct kinds of horizons or layers. These include the surface layer, subsurface layer, subsoil, and underlying material. Soil scientists refer to these layers as A, E, B, and C horizons, respectively.

In this survey area, the surface layer is a layer of organic matter accumulation. It includes what is commonly known as the plow layer but in many soils extends much deeper into the soil.

The subsurface layer is the layer immediately below the surface layer. It is a layer in which clay and organic matter have been removed and a concentration of sand and silt particles of quartz and other minerals resistant to weathering are left behind (see fig. 14 in the section “Soil Series and Detailed Soil Map Units”).

The subsoil is a layer that has undergone some alteration that changed it from the parent material. Some of the most common alterations are the removal of calcium and magnesium carbonate, the addition of clay and organic matter, and the coating of hydroxides of iron or evidence that iron hydroxides have been reduced and removed (see fig. 15 in the section “Soil Series and Detailed Soil Map Units”).

Underlying material is unaltered parent material that has been minimally affected by the soil-forming processes.

After the glaciers melted about 10,000 years ago, soil did not exist. Parent materials were calcareous, or limy, to the surface. One of the important first steps in forming soil from calcareous parent material is the removal of calcium and magnesium carbonate. Calcium and magnesium are abundant in the glacial till and lacustrine deposits in which many of the soils formed. Water is an essential element in the removal of calcium and magnesium. Water passing through organic matter combines with organic compounds to form weak acids, such as carbonic acid. These acid waters percolate downward through the parent material and carry the calcium and magnesium downward in solution. The degree of leaching is largely related to the amount of water passing through the soil.

Storden soils, in strongly convex positions on knolls and hills, have been leached to only a small extent because these landscape positions shed water so rapidly that little water is available to leach the carbonates at a rate faster than the parent material erodes. As a result, calcium and magnesium carbonates are present just as they were when soil formation began (see fig. 17 in the section "Soil Series and Detailed Soil Map Units"). Clarion, Cokato, and Lester soils on the less convex parts of the knolls and hills have a lower runoff rate than the soils in convex positions. Thus they are commonly leached of carbonates to a depth of 18 to 30 inches (see fig. 15 in the section "Soil Series and Detailed Soil Map Units"). Newlondon soils in Kandiyohi till and Sunburg soils in Wadena till are in the same landscape positions as the Storden soils, which formed in New Ulm till. These soils have lost little calcium and magnesium carbonate since soil formation began 10,000 years ago.

In nearly level areas (characterized by Webster soils), drainageways (characterized by Hamel soils), or depressions (characterized by Glencoe soils), runoff from nearby slopes and much of the rainfall that falls on the site are available to leach carbonates. In these settings, particularly in drainageways, the leaching of carbonates is at its maximum. Carbonates are commonly leached to a depth of 5 to more than 6 feet in these areas. Danielson, Forestcity, and Hamel soils, which formed in Kandiyohi, Granite Falls, and New Ulm till, respectively, are examples of deeply leached soils in drainageways on glacial moraines.

Soils on glacial outwash plains that are underlain by sand are mostly leached of carbonates to a depth of about 5 to more than 10 feet. These soils had a relatively small amount of carbonates to begin with. Also, because water can move rapidly downward through these soils, the carbonates and other salts were easily removed. Sparta and Dickman soils are examples of soils that are underlain by sand and are deeply leached of carbonates.

Additional important processes of soil formation are those that affect the color of the subsoil. These processes involve the formation of iron hydroxides. These compounds of iron, oxygen, and water have a significant effect on the color of the subsoil and the underlying parent material. During the early stages of weathering, chemical and physical reactions in the presence of air and water began to take place in the parent material. These processes released iron oxides from soil minerals. The oxides combined with water to form compounds called iron hydroxides. The iron hydroxides in settings where oxygen is relatively abundant are formed by a process called oxidation. The relative abundance of oxygen is closely related to the duration of saturation. It also is determined by how near to the soil surface the saturation occurs. In soils that are never saturated or are saturated for only a very short period, iron hydroxides coat the mineral grains, thus giving the developing subsoil a distinct brownish color. This process is much the same as the rusting of the blade of a steel shovel left out in the rain.

Clarion and Storden soils on the backslopes of hills and Nicollet soils on slight rises have a relative abundance of oxygen for the formation of iron hydroxides, and thus these soils commonly have a brownish subsoil. A brownish subsoil is common in soils, such as Kanaranzi soils, that formed in loamy or sandy material underlain by sand and gravel. Soils that have a brownish subsoil are considered by soil scientists to be well drained or moderately well drained (see figs. 12 and 13 in the section "Soil Series and Detailed Soil Map Units").

Webster soils in nearly level areas and Glencoe soils in closed depressions have a limited availability of oxygen during much or all of the growing season. In these settings the soil is saturated at the surface or within a few feet of the surface for much of the time during which the soil-forming processes are active. On these sites the processes that modify soil colors involve a condition of limited oxygen rather than one of an abundance of oxygen. The iron hydroxides in these areas were produced by a process called reduction. They have less oxygen in their chemical structure. Because of the differing chemical structure of the hydroxides that formed in the saturated soil environment, these hydroxides are mobile. The mobile hydroxides are carried by percolating water and gradually are moved downward into the subsoil or the underlying parent material. The part of the developing subsoil and underlying parent material that is stripped of the mobile iron hydroxides develops a grayish color. The iron hydroxides accumulate in the lower part of the soil and in the upper part of the parent material as red and orange blotches, called iron concentrations. These concentrations occur in root channels and pockets where air was more available.

Soils that have a gray subsoil are considered poorly drained or very poorly drained. Webster soils are poorly drained, and Glencoe soils are very poorly drained. Other examples of poorly drained soils are Cosmos soils that formed in Kandiyohi till (see fig. 11

in the section “Soil Series and Detailed Soil Map Units”). Very poorly drained soils include Lura soils that formed in Kandiyohi till and Lundlake soils that formed in Wadena till. All of these soils formed in settings where the oxygen availability is limited. Among the identifying features of these soils are a gray subsoil and gray parent material.

The removal of iron compounds and carbonates from minerals and rock particles leaves behind minerals that are weakened and can be easily weathered and transformed. As time goes by, an insoluble residue of secondary minerals accumulates, and some of this residue tends to recrystallize and form clays.

As iron and aluminum are weathered and carbonates and other very soluble compounds are removed, a subsoil layer begins to form below a very thin surface layer. In time, depending on the amount of water entering the soil, the thickness of the subsoil increases to as much as 3 or 4 feet in some places.

As soil formation progressed, the processes of forming iron hydroxides (oxidation-reduction) and calcium carbonate leaching became less important. Processes influenced by vegetation as modified by climate and by landscape position became dominant.

The earliest dominant higher forms of plant life to grow on the soil were alder and spruce. It is believed that the spruce forest became established even before the melting of the ice fields was complete. The dominance of spruce was short-lived, however, because as the glacial ice retreated northward to Canada and beyond, the climate soon became warm and dry. The major imprint of vegetation appears to have occurred within the last 7,000 years, when prairie vegetation invaded the area as part of a broad peninsula projecting eastward into western Wisconsin. This invasion of prairie vegetation pushed the woodlands to the east.

Prairie plants produce an abundance of organic matter. If a trench is excavated in the soil so that the soil layers can be viewed, one can see that the roots of prairie plants grow mostly in the upper foot of the soil. Over a period of many years, the decaying of plants, particularly of the roots, has produced at the soil surface an accumulation of dark organic material called humus. Big bluestem, little bluestem, and prairie cordgrass were dominant grass species near the time of European settlement, except in wet closed depressions, where reeds and sedges dominated.

In areas where oxygen was abundant in the soil all year long in most years, the humus accumulated slowly. In these places the dark surface layer at the time of settlement is estimated to have varied in thickness from about 12 to 18 inches. Strout, Wadenill, and Clarion soils formed under tall grass prairie in Kandiyohi till, Granite Falls till, and New Ulm till, respectively. In landscape settings that are saturated for long periods on the glacial moraines, such as nearly level areas and closed depressions, less oxygen is available to oxidize or “burn” the humus. As a result, the humus accumulates to a greater thickness in these areas than in areas where the soil is saturated for shorter periods. In the nearly level areas, the thickness of the dark layers ranges from about 14 to 24 inches. The poorly drained Cosmos, Uniongrove, and Webster soils formed under tall prairie grasses in nearly level areas. These soils formed in Kandiyohi till, Granite Falls till, and New Ulm till, respectively.

The larger depressions remain saturated all year if they are not artificially drained. Water stands on the soil surface for at least part of the growing season. The first plants and animals to become part of the soil in the shallow lakes and ponds were algae and diatoms. The decayed remnants of these plants and animals are referred to as limnic sediments. These sediments accumulated to a thickness of many feet in places. In time, water-tolerant plants, such as reeds and sedges, began to encroach into the ponds and lakes. The abundance of moisture promoted a dense growth. Organic matter accumulated rapidly because little oxygen was available to promote the decay of the reeds and sedges when they died. Many former ponds and shallow lakes are now filled with soils that formed in the thick organic deposits of partially decomposed reeds and sedges. Muskego soils are examples (see fig. 16 in the section “Soil Series and Detailed Soil Map Units”). The upper part of these soils is muck derived from reeds and sedges, and the lower part is limnic sediments derived from the skeletons of microscopic plants.

About 4,000 years ago, the climate began to cool and become more moist and the northern hardwoods known as the “Big Woods” began to spread westward. The Big Woods may have only invaded the survey area within the last 500 to 1,000 years.

Soil temperatures vary depending upon the degree of exposure of the soil surface to the sun. South-facing slopes are warmer and dryer than north-facing slopes. The north-facing aspects of the steeper parts of hills, the north and east sides of lakes and large marshes, and areas near the larger streams have a slightly cooler and moister microclimate than other areas. This small difference in local climate was apparently sufficient to allow trees to compete with prairie grasses. From these cool moist sites, the woodland expanded into the naturally warmer and dryer nearby areas. Tree seedlings were dispersed across the landscape by birds and mammals. It is believed that scattered areas of woodland persisted through the earlier warm period. In contrast with the scattered woodlands that occurred over the centuries since the onset of cooling, woodland has replaced much of the tall grass prairies in much of the county. The expansion of the woodland did not proceed uniformly, however, because prairie fires often burned the woodland and allowed the prairie vegetation to dominate for a short time.

The westward expansion of woodland was interrupted by the arrival of European settlers. At that time, except for areas mostly around the north and east sides of lakes and large marshes, areas in the western part of the county were still prairie. Prairie also persisted in places in the eastern part of the county on soils that are dominantly poorly drained, such as Uniongrove soils, or that have a low capacity to store moisture. Many of the common hardwoods do not compete well with soils that are saturated for long periods. Further, the poorly drained soils are nearly level and thus do not have the advantage of a northern aspect, which provides soils on relatively steep slopes with a cooler microclimate. Also, trees do not compete well with prairie grass when the soil has a low capacity to store moisture. Grasses are able to withstand the long dry summers that are common in the survey area, but tree seedlings tend to die under similar conditions. Soils that hindered the advance of woodland are those that are shallow to sand or gravelly sand, such as Sparta, Dickman, and Estherville soils.

With the invasion of the hardwoods, the characteristics of the soils that formed under the tall grass prairie began to change in response to processes that occur under woodland vegetation. In contrast to prairie plants, forests produce little organic matter below ground level. Instead, the organic matter tends to accumulate at the soil surface. Additionally, the litter of leaves and decaying limbs and trunks of trees is more acid than prairie vegetation in areas of the same parent material. Thus, moisture percolating through decaying forest vegetation became more acid than under prairie vegetation. This acid condition caused clay and organic matter and certain other minerals to be carried downward into the subsoil. The dark surface layer that formed during the earlier warmer and dry time began to thin as clay, organic matter, and other minerals were removed. A thin bleached subsurface layer began to form just below the thinning dark surface soil. The downward migrating clay and organic matter removed from the subsurface layer accumulated in the subsoil. Subsoil development in forest soils, particularly evident in soils that formed in loamy or clayey material, is believed to relate to wetting and drying of the soil in addition to the accumulation of clay. The formation of cracks in the subsoil provides pathways that allow moisture to carry the waxy material downward, where it is precipitated in pores, in channels, and on the surfaces of nearly cubical or rectangular blocky structural forms.

In general, forest soils have a black or very dark brown surface layer that is 2 to 3 inches thick; an ashy gray or grayish brown subsurface layer 5 to 10 inches thick that is low in clay and organic matter; and a dense subsoil layer that features blocky structures covered with patches of dark waxy coatings of clay and organic matter that were leached from the subsurface layer.

Most of the soils that supported trees at the time of early settlement have not been wooded long enough for the formation of a true forest soil. Most of the soils on the formerly wooded slopes in the eastern half of the county are considered transitional between prairie soils and forest soils. Before tillage was begun, the prairie-forest soils commonly had a black or very dark brown or very dark gray surface layer 4 to 10 inches thick (which is also characteristic of prairie soils) underlain by layers characteristic of forest soils, including a thin, ashy gray or grayish brown subsurface layer 3 to 4 inches thick and a subsoil with accumulations of clay on fairly strongly developed structural blocks. In places the subsurface layer is indistinct.

When the settlers began to till these prairie-forest soils, the surface layer and subsurface layer were mixed. In a few years the tilled layer developed the dark grayish brown hue (dry color) characteristic of soils that formed under both prairie and forest vegetation. Koronis and Lester soils are examples of prairie-forest soils. These soils are on many of the cultivated hills in the eastern part of the county. Koronis and Lester soils are associated with Sunburg and Storden soils, respectively. The Sunburg and Storden soils are on the upper convex and steeper parts of slopes.

One of the most important soil-forming processes in the county is the formation of “high lime” areas on rims of depressions. The rims are simply the result of calcium and magnesium carbonate and other compounds moving laterally and upward from the soils in depressions to the surrounding elevated rims. This process takes place during the normally dry summer months. The carbonates and other compounds are carried in both lateral and upward directions by soil moisture migrating from wet soil to dryer soil. Where moisture encounters dry soil, it can no longer carry the lime and associated compounds, and thus these materials precipitate near the soil surface.

Human activity influences soil formation in many ways. Tillage exposes the soil to air, thereby accelerating the oxidation of organic matter. Erosion of the surface layer has been accelerated on some steeply sloping soils because of tillage, and areas below these slopes have received deposits of eroded material. Artificial drainage affects soil formation by allowing water to leach carbonates and salts from the "high lime" soils.

Changes in vegetation, such as those that took place in the original Big Woods and the tall grass prairie, may also affect soil formation.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA, 1975). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. The table "Classification of the Soils" in Parts I and II of this publication shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Twelve soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol.* An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Endoaquolls (*Endo*, meaning within, plus *aquoll*, the suborder of the Mollisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Endoaquolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, thickness of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, mesic Typic Endoaquolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Classification of the Soils

Soil name	Family or higher taxonomic class
Angus	Mollic Hapludalfs, fine-loamy, mixed, mesic
Arkton	Aquic Hapludolls, fine-loamy, mixed, mesic
Barry	Typic Argiaquolls, fine-loamy, mixed, mesic
Biscay	Typic Endoaquolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Blue Earth	Mollic Fluvaquents, fine-silty, mixed (calcareous), mesic
Bold	Typic Udorthents, coarse-silty, mixed (calcareous), mesic
Calco	Cumulic Haplaquolls, fine-silty, mixed (calcareous), mesic
Canisteo	Typic Endoaquolls, fine-loamy, mixed (calcareous), mesic
Chelsea	Argic Udipsamments, mixed, mesic
Clarion	Typic Hapludolls, fine-loamy, mixed, mesic
Cohoctah	Fluvaquentic Endoaquolls, coarse-loamy, mixed, mesic
Cokato	Typic Argiudolls, fine-loamy, mixed, mesic
Collinwood	Aquertic Hapludolls, fine, montmorillonitic, mesic
Cordova	Typic Argiaquolls, fine-loamy, mixed, mesic
Corvuso	Typic Calciaquolls, fine, mesic
Cosmos	Vertic Epiaquolls, fine, montmorillonitic, mesic
Crowriver	Typic Calciaquolls, coarse-loamy, mesic
Cylinder	Aquic Hapludolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Danielson	Cumulic Vertic Epiaquolls, fine, montmorillonitic, mesic
Darfur	Typic Endoaquolls, coarse-loamy, mixed, mesic
Dassel	Typic Endoaquolls, coarse-loamy, mixed, mesic
Dickman	Typic Hapludolls, sandy, mixed, mesic
Estherville	Typic Hapludolls, sandy, mixed, mesic
Fieldon	Typic Endoaquolls, coarse-loamy, mixed (calcareous), mesic
Forestcity	Typic Argiaquolls, fine-loamy, mixed, mesic
Gardencity	Typic Hapludolls, coarse-loamy, mixed, mesic
Glencoe	Cumulic Endoaquolls, fine-loamy, mixed, mesic
Granby	Typic Endoaquolls, sandy, mixed, mesic
Grovecity	Aquic Hapludolls, coarse-loamy, mixed, mesic
Hamel	Typic Argiaquolls, fine-loamy, mixed, mesic
Harps	Typic Calciaquolls, fine-loamy, mesic
Havelock	Cumulic Endoaquolls, fine-loamy, mixed (calcareous), mesic
Hawick	Entic Hapludolls, sandy, mixed, mesic
Houghton	Typic Medisaprists, euic, mesic
Kanaranzi	Typic Hapludolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Kandiyohi	Aquertic Hapludolls, fine, montmorillonitic, mesic
Kingston	Aquic Hapludolls, fine-silty, mixed, mesic
Klossner	Terric Medisaprists, loamy, mixed, euic, mesic
Koronis	Mollic Hapludalfs, fine-loamy, mixed, mesic
Lester	Mollic Hapludalfs, fine-loamy, mixed, mesic
Le Sueur	Aquic Argiudolls, fine-loamy, mixed, mesic
Litchfield	Aquic Hapludolls, sandy, mixed, mesic
Lundlake	Cumulic Endoaquolls, fine-loamy, mixed, mesic
Lura	Cumulic Vertic Epiaquolls, fine, montmorillonitic, mesic
Madelia	Typic Endoaquolls, fine-silty, mixed, mesic
Marcellon	Aquic Argiudolls, fine-loamy, mixed, mesic
Mayer	Typic Endoaquolls, fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic
Medo	Terric Medisaprists, loamy, mixed, euic, mesic
Minneopa	Aquic Hapludolls, sandy, mixed, mesic
Muskego	Limnic Medisaprists, coprogenous, euic, mesic
Newlondon	Aquic Eutrochrepts, fine-loamy, mixed, mesic
Nicollet	Aquic Hapludolls, fine-loamy, mixed, mesic
Okoboji	Cumulic Vertic Endoaquolls, fine, montmorillonitic, mesic
Omsrud	Typic Hapludolls, fine-loamy, mixed, mesic
Reedslake	Typic Argiudolls, fine-loamy, mixed, mesic
Rohrbeck	Arenic Hapludalfs, loamy, mixed, mesic
Rolfe	Typic Argialbolls, fine, montmorillonitic, mesic
Seaforth	Aquic Calciudolls, fine-loamy, mixed, mesic
Shorewood	Aquertic Argiudolls, fine, montmorillonitic, mesic
Sparta	Entic Hapludolls, sandy, mixed, mesic
Spicer	Typic Endoaquolls, fine-silty, mixed (calcareous), mesic
Storden	Typic Eutrochrepts, fine-loamy, mixed, mesic
Strout	Vertic Hapludolls, fine, montmorillonitic, mesic
Sunburg	Typic Udorthents, coarse-loamy, mixed (calcareous), mesic

Classification of the Soils--Continued

Soil name	Family or higher taxonomic class
Swanlake	Typic Calciudolls, fine-loamy, mixed, mesic
Swedegrove	Typic Endoaquolls, coarse-loamy, mixed (calcareous), mesic
Truman	Typic Hapludolls, fine-silty, mixed, mesic
Udipsamments	Udipsamments
Udorthents	Udorthents
Uniongrove	Typic Endoaquolls, coarse-loamy, mixed, mesic
Wadena	Typic Hapludolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Wadenill	Typic Hapludolls, coarse-loamy, mixed, mesic
Waldorf	Vertic Epiaquolls, fine, montmorillonitic, mesic
Webster	Typic Endoaquolls, fine-loamy, mixed, mesic
Zook	Cumulic Vertic Endoaquolls, fine, montmorillonitic, mesic

Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
8B	Sparta loamy sand, 1 to 6 percent slopes	3,361	0.8
8C	Sparta loamy sand, 6 to 12 percent slopes	992	0.2
8D	Sparta loamy sand, 12 to 25 percent slopes	547	0.1
35	Blue Earth mucky silt loam, 0 to 1 percent slopes	1,195	0.3
39A	Wadena loam, 0 to 2 percent slopes	1,234	0.3
41A	Estherville sandy loam, 0 to 2 percent slopes	5,820	1.4
85	Calco silty clay loam, 0 to 2 percent slopes, occasionally flooded	1,320	0.3
86	Canisteo clay loam, moderately fine substratum, 0 to 2 percent slopes	2,709	0.7
96B	Collinwood silty clay loam, 3 to 6 percent slopes	1,555	0.4
101B	Truman silt loam, 2 to 6 percent slopes	2,339	0.6
102B	Clarion loam, moderately fine substratum, 2 to 5 percent slopes	4,787	1.2
106C2	Lester loam, 6 to 12 percent slopes, eroded	1,737	0.4
112	Harps clay loam, 0 to 2 percent slopes	1,317	0.3
113	Webster clay loam, 0 to 2 percent slopes	4,327	1.0
114	Glencoe clay loam, depressional, 0 to 1 percent slopes	1,610	0.4
129	Cylinder loam, 0 to 1 percent slopes	1,088	0.3
130	Nicollet clay loam, 1 to 3 percent slopes	3,798	0.9
134	Okoboji silty clay loam, depressional, 0 to 1 percent slopes	3,246	0.8
136	Madelia silty clay loam, 0 to 2 percent slopes	2,750	0.7
140	Spicer silty clay loam, 0 to 2 percent slopes	2,800	0.7
143B	Chelsea loamy fine sand, 1 to 6 percent slopes	762	0.2
178	Granby fine sandy loam, 0 to 1 percent slopes	1,196	0.3
181	Litchfield loamy fine sand, 0 to 2 percent slopes	3,836	0.9
183	Dassel mucky fine sandy loam, depressional, 0 to 1 percent slopes	323	*
197	Kingston silty clay loam, 1 to 3 percent slopes	3,512	0.9
211	Lura silty clay, depressional, 0 to 1 percent slopes	2,933	0.7
229	Waldorf silty clay loam, 0 to 2 percent slopes	2,728	0.7
239	Le Sueur clay loam, 1 to 3 percent slopes	1,823	0.4
281	Darfur loam, 0 to 2 percent slopes	2,363	0.6
286B	Shorewood silty clay loam, 3 to 6 percent slopes	1,299	0.3
311C2	Shorewood silty clay, 6 to 12 percent slopes, eroded	827	0.2
327A	Dickman sandy loam, 0 to 2 percent slopes	3,671	0.9
327B	Dickman sandy loam, 2 to 6 percent slopes	1,599	0.4
399	Biscay loam, depressional, 0 to 1 percent slopes	442	0.1
415	Kanaranzi loam, 0 to 3 percent slopes	4,409	1.1
423	Seaforth loam, 1 to 3 percent slopes	1,909	0.5
461B	Koronis loam, 2 to 6 percent slopes	19,382	4.7
461C2	Koronis loam, 6 to 12 percent slopes, eroded	8,792	2.1
511	Marcellon loam, 0 to 3 percent slopes	7,567	1.8
523	Houghton muck, depressional, 0 to 1 percent slopes	441	0.1
525	Muskego muck, depressional, 0 to 1 percent slopes	1,047	0.3
539	Klossner muck, depressional, 0 to 1 percent slopes	3,920	0.9
548	Medo muck, depressional, 0 to 1 percent slopes	600	0.1
610	Calco silty clay loam, 0 to 1 percent slopes, frequently flooded	1,178	0.3
611D	Hawick gravelly sandy loam, 12 to 25 percent slopes	1,128	0.3
612B	Wadenill loam, 2 to 6 percent slopes	6,564	1.6
613	Grovecity loam, 1 to 3 percent slopes	5,545	1.3
664	Zook silty clay loam, 0 to 2 percent slopes, occasionally flooded	586	0.1
740	Hamel-Glencoe, depressional, complex, 0 to 3 percent slopes	6,903	1.7
804B	Koronis-Sunburg-Hawick complex, 2 to 6 percent slopes	1,168	0.3
804C2	Koronis-Sunburg-Hawick complex, 6 to 12 percent slopes, eroded	1,997	0.5
804D2	Koronis-Sunburg-Hawick complex, 12 to 18 percent slopes, eroded	1,021	0.2
804E	Koronis-Sunburg-Hawick complex, 18 to 40 percent slopes	1,509	0.4
805C2	Sunburg-Wadenill complex, 6 to 12 percent slopes, eroded	4,222	1.0
805D2	Sunburg-Wadenill complex, 12 to 18 percent slopes, eroded	1,105	0.3
807D2	Koronis-Sunburg complex, 12 to 18 percent slopes, eroded	2,674	0.6
875B	Estherville-Hawick complex, 2 to 6 percent slopes	7,229	1.8
875C	Hawick-Estherville complex, 6 to 12 percent slopes	1,980	0.5
887B	Clarion-Swanlake complex, 2 to 6 percent slopes	7,263	1.8
899	Harps-Okoboji, depressional, complex, 0 to 2 percent slopes	4,467	1.1
909C2	Bold-Truman complex, 6 to 12 percent slopes, eroded	954	0.2
909D2	Bold-Truman complex, 12 to 18 percent slopes, eroded	325	*

See footnote at end of table.

Acreage and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
920B	Clarion-Storden-Hawick complex, 2 to 6 percent slopes	1,011	0.2
945D2	Lester-Storden complex, 12 to 18 percent slopes, eroded	1,003	0.2
945E	Lester-Storden complex, 18 to 40 percent slopes	1,595	0.4
956	Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes	9,838	2.4
960C2	Storden-Omsrud complex, 6 to 12 percent slopes, eroded	9,805	2.4
960D2	Storden-Omsrud complex, 12 to 18 percent slopes, eroded	4,655	1.1
978	Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes	683	0.2
1015	Udipsamments (cut and fill land)	558	0.1
1016	Udorthents, loamy (cut and fill land)	788	0.2
1030	Pits, gravel-Udipsamments complex	558	0.1
1080	Klossner, Okoboji, and Glencoe soils, ponded, 0 to 1 percent slopes	6,223	1.5
1096	Fieldon-Dassel, depressional, complex, 0 to 2 percent slopes	4,302	1.0
1097	Mayer-Biscay, depressional, complex, 0 to 2 percent slopes	5,668	1.4
1098	Biscay-Biscay, depressional, complex, 0 to 2 percent slopes	3,134	0.8
1099	Granby loamy fine sand, very wet, 0 to 1 percent slopes	621	0.2
1100	Nicollet silty clay loam, 1 to 3 percent slopes	4,560	1.1
1101	Webster silty clay loam, moderately fine substratum, 0 to 2 percent slopes	5,287	1.3
1159B	Strout-Arkton complex, 2 to 6 percent slopes	4,769	1.2
1161	Barry loam, 0 to 2 percent slopes	3,609	0.9
1162A	Kandiyohi clay, 0 to 2 percent slopes	4,506	1.1
1162B	Kandiyohi clay, 2 to 5 percent slopes	4,013	1.0
1163	Cohoctah loam, 0 to 2 percent slopes, frequently flooded	3,743	0.9
1165	Lundlake silty clay loam, depressional, 0 to 1 percent slopes	3,236	0.8
1168	Swedegrove-Lundlake, depressional, complex, 0 to 2 percent slopes	9,982	2.4
1169	Corvuso-Lura, depressional, complex, 0 to 2 percent slopes	3,724	0.9
1171C	Newlondon-Strout complex, 6 to 12 percent slopes, eroded	4,596	1.1
1171D	Newlondon-Strout complex, 12 to 18 percent slopes, eroded	1,074	0.3
1172C	Sparta-Gardencity complex, 6 to 12 percent slopes	445	0.1
1173	Muskego and Klossner soils, depressional, 0 to 1 percent slopes, frequently flooded	3,398	0.8
1174	Danielson clay loam, 1 to 3 percent slopes	4,900	1.2
1175	Swedegrove loam, 0 to 2 percent slopes	4,889	1.2
1176	Litchfield sandy loam, 0 to 2 percent slopes	1,009	0.2
1177C	Gardencity-Bold complex, 6 to 12 percent slopes, eroded	501	0.1
1178	Uniongrove loam, 0 to 2 percent slopes	8,365	2.0
1183	Crowriver loam, 0 to 2 percent slopes	5,911	1.4
1184	Corvuso silty clay loam, 0 to 2 percent slopes	2,320	0.6
1185	Gardencity fine sandy loam, moderately wet, 0 to 2 percent slopes	729	0.2
1186	Forestcity-Lundlake, depressional, complex, 0 to 3 percent slopes	8,250	2.0
1192	Crowriver-Lundlake, depressional, complex, 0 to 2 percent slopes	1,714	0.4
1193	Cosmos silty clay, 0 to 2 percent slopes	7,598	1.8
1197	Cohoctah fine sandy loam, 0 to 2 percent slopes, occasionally flooded	598	0.1
1198B	Rohrbeck-Koronis complex, 1 to 6 percent slopes	1,355	0.3
1199	Klossner and Lundlake soils, ponded	5,478	1.3
1203	Muskego, Blue Earth, and Houghton soils, ponded	21,417	5.2
1204B	Reedslake loam, 2 to 5 percent slopes	10,856	2.6
1213C	Cokato-Storden complex, 6 to 12 percent slopes, eroded	4,298	1.0
1220C	Cokato-Storden-Hawick complex, 6 to 12 percent slopes, eroded	1,490	0.4
1356	Water, miscellaneous	85	*
1362B	Angus loam, 2 to 5 percent slopes	2,019	0.5
1383A	Shorewood silty clay loam, moderately wet, 0 to 3 percent slopes	817	0.2
1384	Minneopa loam, 0 to 2 percent slopes	2,575	0.6
1385	Havelock loam, 0 to 2 percent slopes, frequently flooded	31	*
1387A	Collinwood silty clay loam, moderately wet, 0 to 3 percent slopes	1,580	0.4
1391B	Wadenill-Sunburg complex, 2 to 6 percent slopes	4,971	1.2
1406	Medo, Dassel, and Biscay soils, ponded, 0 to 1 percent slopes	3,699	0.9
1801B	Gardencity very fine sandy loam, 2 to 6 percent slopes	1,971	0.5
W	Water	13,800	3.3
	Total	412,900	100.0

* Less than 0.1 percent.

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Soil Series and Detailed Soil Map Units

In this section, arranged in alphabetical order, each soil series recognized in the survey area is described. Each series description is followed by descriptions of the associated detailed soil map units.

Characteristics of the soil and the material in which it formed are identified for each soil series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units on the detailed soil maps in this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information about each map unit is given in Part II of this survey.

A map unit delineation on the detailed soil maps represents an area on the landscape and consists of one or more soils or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit. The principal hazards and limitations to be considered in planning for specific uses are described in Part II of this survey.

Soils that have profiles that are almost alike make up a *soil series.* Except for differences in texture of the surface layer or of the underlying layers, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying layers. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases.* Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Clarion loam, moderately fine substratum, 2 to 5 percent slopes, is a phase of the Clarion series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Clarion-Swanlake complex, 2 to 6 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Klossner, Okoboji, and Glencoe soils, ponded, 0 to 1 percent slopes, is an undifferentiated group in this survey area.

This survey includes *miscellaneous areas.* Such areas have little or no soil material and support little or no vegetation. The Pits component of the Pits, gravel-Udipsamments complex is an example.

The table “Acreage and Proportionate Extent of the Soils” in Parts I and II of this survey gives the acreage and proportionate extent of each map unit. Other tables (see Contents) give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

Angus Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 2 to 5 percent
Taxonomic classification: Fine-loamy, mixed, mesic Mollic Hapludalfs

Typical Pedon

Angus loam, 2 to 5 percent slopes, 650 feet east and 350 feet south of the northwest corner of sec. 11, T. 118 N., R. 30 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; friable; about 1 percent gravel; slightly acid; abrupt smooth boundary.

Bt1—9 to 20 inches; yellowish brown (10YR 5/4) clay loam; weak fine prismatic structure parting to moderate medium subangular blocky; firm; many brown or dark brown (10YR 4/3) organic coatings on faces of peds; common dark brown (10YR 3/3) clay films on faces of peds and in pores; about 3 percent gravel; moderately acid; clear smooth boundary.

Bt2—20 to 29 inches; yellowish brown (10YR 5/4) clay loam; moderate coarse subangular blocky structure; friable; many brown or dark brown (10YR 4/3) organic coatings on faces of peds; common very dark grayish brown (10YR 3/2) clay films in root channels; about 3 percent gravel; moderately acid; gradual smooth boundary.

Bw—29 to 35 inches; light olive brown (2.5Y 5/4) loam; moderate coarse subangular blocky structure; friable; about 3 percent gravel; slightly acid; gradual smooth boundary.

Bk—35 to 60 inches; light olive brown (2.5Y 5/4) loam; weak coarse subangular blocky structure; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; friable; about 3 percent gravel; about 1 percent cobbles and stones; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 20 to 54 inches
Thickness of the mollic epipedon: 6 to 10 inches

A horizon:
Hue—10YR
Value—2 or 3 moist; 5 or 6 dry
Chroma—1 to 3
Texture—loam or clay loam
Content of rock fragments—1 to 8 percent gravel; 0 to 1 percent cobbles and stones

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—loam or clay loam
Content of rock fragments—1 to 8 percent gravel; 1 to 2 percent cobbles and stones

Bk horizon:
Hue—2.5Y
Value—4 to 6
Chroma—4

Texture—loam
Content of rock fragments—1 to 9 percent gravel; 1 to 4 percent cobbles and stones

1362B—Angus loam, 2 to 5 percent slopes

Composition

Angus and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 2 to 5 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 80 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cordova and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Arkton Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Moraines
Parent material: Till
Slope range: 4 to 6 percent
Taxonomic classification: Fine-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Arkton clay loam, in an area of Strout-Arkton complex, 2 to 6 percent slopes, 1,700 feet west and 550 feet south of the northeast corner of sec. 12, T. 117 N., R. 31 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; firm; about 1 percent gravel; about 4 percent cobbles; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—9 to 25 inches; light olive brown (2.5Y 5/4) clay loam; moderate medium angular blocky structure parting to moderate very fine angular blocky; firm; few fine distinct light brownish gray (2.5Y 6/2) iron depletions; few fine irregular soft white (10YR 8/2) concentrations of calcium carbonate distributed uniformly throughout the horizon; about 1 percent gravel; about 4 percent cobbles; strongly effervescent; slightly alkaline; gradual wavy boundary.

Bk2—25 to 60 inches; light olive brown (2.5Y 5/4) clay loam; weak coarse prismatic structure parting to moderate fine angular blocky; firm; common coarse distinct light brownish gray (2.5Y 6/2) iron depletions; common fine irregular soft white (10YR 8/2) concentrations of calcium carbonate distributed uniformly throughout the horizon; few dark yellowish brown (10YR 4/6) iron concentrations in ped interiors; few black (10YR 2/1) concentrations of manganese; about 1 percent gravel; about 4 percent cobbles; violently effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 7 to 12 inches

Ap horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2
Texture—clay loam
Content of rock fragments—1 to 2 percent gravel; 0 to 4 percent cobbles and stones

Bk horizon:
Hue—2.5Y
Value—4 or 5

Chroma—2 to 4
Texture—clay, silty clay, or clay loam
Content of rock fragments—1 to 5 percent gravel; 1 to 4 percent cobbles and stones

Barry Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy, mixed, mesic Typic Argiaquolls

Typical Pedon

Barry loam, 0 to 2 percent slopes, 2,450 feet south and 150 feet east of the northwest corner of sec. 9, T. 121 N., R. 31 W.

Ap—0 to 11 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; friable; 2 percent gravel; slightly acid; abrupt smooth boundary.

Btg1—11 to 15 inches; olive gray (5Y 4/2) sandy clay loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; few very dark gray (10YR 3/1) clay films on faces of peds and in pores; 2 percent gravel; neutral; 1 percent cobbles; clear smooth boundary.

Btg2—15 to 28 inches; olive gray (5Y 4/2) sandy clay loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; firm; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; few very dark gray (10YR 3/1) clay films on faces of peds and in pores; 4 percent gravel; 2 percent cobbles; neutral; clear smooth boundary.

Bkg1—28 to 33 inches; olive gray (5Y 5/2) sandy clay loam; weak medium subangular blocky structure; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; few very dark gray (10YR 3/1) clay films in pores; 3 percent gravel; 1 percent cobbles; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg2—33 to 60 inches; light olive gray (5Y 6/2) sandy loam; weak coarse subangular blocky structure; friable; many medium prominent light olive brown (2.5Y 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) concentrations of calcium carbonate distributed uniformly throughout the horizon; few dark brown (7.5YR 4/4) concentrations of manganese; about 4 percent gravel; 2 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 48 inches
Thickness of the mollic epipedon: 10 to 15 inches

A horizon:
Hue—neutral, 10YR, or 2.5Y
Value—2 or 3
Chroma—0 or 1
Texture—loam
Content of rock fragments—1 to 3 percent gravel; 1 to 2 percent cobbles and stones

Btg horizon:
Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam or sandy clay loam
Content of rock fragments—3 to 6 percent gravel; 2 to 5 percent cobbles and stones

Bkg horizon:
Hue—5Y
Value—5 or 6
Chroma—1 or 2
Texture—fine sandy loam or sandy loam; thin horizons of loam in some pedons
Content of rock fragments—4 to 8 percent gravel; 2 to 6 percent cobbles and stones

1161—Barry loam, 0 to 2 percent slopes

Composition

Barry and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 1.0 to 2.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.0 inches (high)
Content of organic matter in the surface layer: About 5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lundlake and similar soils
- Marcellon and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Biscay Series

Depth class: Very deep
Drainage class: Poorly drained and very poorly drained
Permeability: Moderate in the loamy mantle and very rapid in the sandy and gravelly underlying material
Landform: Outwash plains and terraces
Parent material: Glacial outwash
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Endoaquolls

Typical Pedon

Biscay loam, in an area of Biscay-Biscay, depressional, complex, 0 to 2 percent slopes, 3,000 feet south and 1,600 feet east of the northwest corner of sec. 36, T. 121 N., R. 31 W.

Ap—0 to 9 inches; black (N 2/0) loam; weak very fine subangular blocky structure; very friable; neutral; abrupt smooth boundary.
A1—9 to 16 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; very friable; neutral; clear smooth boundary.
A2—16 to 20 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; very friable; neutral; clear wavy boundary.
Bg—20 to 25 inches; olive gray (5Y 5/2) loam; weak fine subangular blocky structure; very friable; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; common olive gray (5Y 4/2) organic coatings on faces of peds; neutral; clear smooth boundary.
2Cg1—25 to 36 inches; olive gray (5Y 4/2) gravelly coarse sand; single grain; loose; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; 20 percent gravel; neutral; clear smooth boundary.
2Cg2—36 to 60 inches; olive gray (5Y 5/2) gravelly coarse sand; single grain; loose; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; 25 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Thickness of the loamy mantle: Commonly 20 to 28 inches; ranges from 20 to 40 inches
Thickness of the mollic epipedon: 16 to 24 inches

A horizon:
Hue—10YR or neutral
Value—2
Chroma—0 or 1
Texture—loam, mucky loam, or clay loam
Content of rock fragments—0 to 2 percent gravel

Bg horizon:
Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam or clay loam
Content of rock fragments—0 to 5 percent gravel

2C horizon:
Hue—5Y
Value—4 or 5
Chroma—1 or 2
Texture—stratified loamy coarse sand, loamy sand, coarse sand, or sand or the gravelly analogs of these textures
Content of rock fragments—5 to 50 percent gravel

399—Biscay loam, depressional, 0 to 1 percent slopes

Composition

Biscay and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Depressions on outwash plains and terraces
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches

Drainage class: Very poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 6.0 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Mayer and similar soils
- Klossner and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1098—Biscay-Biscay, depressional, complex, 0 to 2 percent slopes

Composition

Biscay and similar soils: About 70 percent
Biscay, depressional, and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Biscay—flats and swales on outwash plains and terraces; Biscay, depressional—depressions on outwash plains and terraces
Slope range: Biscay—0 to 2 percent; Biscay, depressional—0 to 1 percent

Component Description

Biscay

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 6.2 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

Biscay, depressional

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 6.1 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Mayer and similar soils
- Minneopa and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Blue Earth Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate
Landform: Lake beds and moraines
Parent material: Coprogenous earth
Slope range: 0 to 1 percent
Taxonomic classification: Fine-silty, mixed (calcareous), mesic Mollic Fluvaquents

Typical Pedon

Blue Earth mucky silt loam, 0 to 1 percent slopes, 1,050 feet west and 200 feet south of the northeast corner of sec. 2, T. 117 N., R. 31 W.

Ap—0 to 8 inches; very dark gray (N 3/0) mucky silt loam (coprogenous earth), gray (5Y 5/1) dry; weak very fine granular structure; very friable; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; common fine roots; 2 percent snail shells and snail-shell fragments; violently effervescent; slightly alkaline; clear smooth boundary.
C1—8 to 20 inches; black (10YR 2/1) mucky silt loam (coprogenous earth), dark gray (5Y 4/1) dry; weak thick platy structure; very friable; few fine prominent dark brown (7.5YR 4/4) iron concentrations; few fine roots; 4 percent snail shells and snail-shell fragments; strongly effervescent; slightly alkaline; gradual smooth boundary.
C2—20 to 36 inches; very dark gray (5Y 3/1) mucky silt loam (coprogenous earth), gray (5Y 5/1) dry; weak thick platy structure; very friable; few medium prominent dark brown (7.5YR 4/4) iron concentrations; few fine roots; 5 percent snail shells and snail-shell fragments; strongly effervescent; slightly alkaline; clear smooth boundary.
C3—36 to 60 inches; black (10YR 2/1) mucky silt loam (coprogenous earth), gray (5Y 5/1) dry; weak thick platy structure; friable; few fine prominent dark brown (7.5YR 4/4) iron concentrations; few fine roots; 5 percent snail shells and snail-shell fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the coprogenous earth: 30 to 60 inches
Carbonates: At the surface
Content of rock fragments: 0 to 8 percent snail-shell fragments

Ap horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—mucky silt loam or muck

C horizon:
Hue—10YR to 5Y
Value—2 to 4
Chroma—1 or 2
Texture—silt loam, silty clay loam, loam, or the mucky analogs of these textures

35—Blue Earth mucky silt loam, 0 to 1 percent slopes

Composition

Blue Earth and similar soils: About 95 percent
Inclusions: About 5 percent

Setting

Landform: Lake beds
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Mucky silt loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Coprogenous earth
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 12.6 inches (high)
Content of organic matter in the surface layer: About 17.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Canisteo and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Bold Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Lake plains, outwash plains, and terraces
Parent material: Lacustrine deposits

Slope range: 6 to 18 percent
Taxonomic classification: Coarse-silty, mixed (calcareous), mesic Typic Udorthents

Typical Pedon

Bold silt loam, in an area of Bold-Truman complex, 6 to 12 percent slopes, eroded, 200 feet west and 56 feet north of the southeast corner of sec. 20, T. 120 N., R. 29 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; cloddy; very friable; slightly effervescent; neutral; clear smooth boundary.
Bk1—7 to 20 inches; light olive brown (2.5Y 5/4) silt loam; weak coarse subangular blocky structure; very friable; very few white (10YR 8/2) threads and masses of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.
Bk2—20 to 60 inches; light yellowish brown (2.5Y 6/4) silt loam; weak thin platy structure; very friable; few fine distinct light olive brown (2.5Y 5/6) iron concentrations; few white (10YR 8/2) threads and masses of calcium carbonate; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 7 to 10 inches

A horizon:
Hue—10YR
Value—4 or 5
Chroma—2 to 4
Texture—silt loam

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 6
Texture—silt loam

909C2—Bold-Truman complex, 6 to 12 percent slopes, eroded

Composition

Bold and similar soils: About 55 percent
Truman and similar soils: About 35 percent
Inclusions: About 10 percent

Setting

Landform: Lake plains
Position on the landform: Bold—shoulders and summits; Truman—summits and backslopes
Slope range: 6 to 12 percent

Component Description

Bold

Surface layer texture: Silt loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 13.2 inches (high)
Content of organic matter in the surface layer: About 1.25 percent (moderately low)

Truman

Surface layer texture: Silt loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.8 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Madelia and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

909D2—Bold-Truman complex, 12 to 18 percent slopes, eroded

Composition

Bold and similar soils: About 65 percent
Truman and similar soils: About 25 percent
Inclusions: About 10 percent

Setting

Landform: Lake plains

Position on the landform: Bold—backslopes and shoulders; Truman—backslopes
Slope range: 12 to 18 percent

Component Description

Bold

Surface layer texture: Silt loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 13.2 inches (high)
Content of organic matter in the surface layer: About 1.25 percent (moderately low)

Truman

Surface layer texture: Silt loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.8 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Madelia and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Calco Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 2 percent
Taxonomic classification: Fine-silty, mixed (calcareous), mesic Cumulic Endoaquolls

Typical Pedon

Calco silty clay loam, 0 to 1 percent slopes, frequently flooded, 2,400 feet south and 650 feet east of the northwest corner of sec. 12, T. 117 N., R. 32 W.

A1—0 to 6 inches; very dark gray (N 3/0) silty clay loam; weak fine granular structure; friable; strongly effervescent; slightly alkaline; clear smooth boundary.
A2—6 to 17 inches; black (N 2/0) silty clay loam; moderate fine angular blocky structure parting to moderate very fine angular blocky; friable; strongly effervescent; slightly alkaline; gradual smooth boundary.
Bg1—17 to 26 inches; very dark gray (5Y 3/1) silty clay loam; weak fine subangular blocky structure parting to moderate very fine subangular blocky; friable; strongly effervescent; slightly alkaline; gradual smooth boundary.
Bg2—26 to 39 inches; very dark gray (5Y 3/1) silty clay loam; moderate medium angular blocky structure parting to moderate very fine angular blocky; friable; strongly effervescent; slightly alkaline; gradual smooth boundary.
Bg3—39 to 48 inches; very dark gray (5Y 3/1) silty clay loam; moderate medium angular blocky structure parting to moderate very fine angular blocky; friable; strongly effervescent; slightly alkaline; gradual smooth boundary.
Bg4—48 to 55 inches; very dark gray (5Y 3/1) silty clay loam; moderate medium angular blocky structure parting to moderate very fine angular blocky; friable; strongly effervescent; slightly alkaline; clear smooth boundary.
Cg—55 to 60 inches; dark gray (5Y 4/1) clay loam; weak coarse subangular blocky structure; friable; common medium prominent olive brown (2.5Y 4/4) iron concentrations; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface
Thickness of the mollic epipedon: 40 to more than 60 inches

A horizon:
Hue—10YR, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silt loam or silty clay loam

Bg horizon:
Hue—5Y or neutral

Value—3
Chroma—0 or 1
Texture—silty clay loam

Cg horizon:
Hue—5Y or neutral
Value—4
Chroma—0 or 1
Texture—mainly silty clay loam; loam, clay loam, or silty clay loam below a depth of 40 inches

85—Calco silty clay loam, 0 to 2 percent slopes, occasionally flooded

Composition

Calco and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats on flood plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Alluvium
Flooding: Occasional (fig. 9)
Seasonal high water table: At the surface to 1 foot below the surface
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 13.2 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Havelock and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

610—Calco silty clay loam, 0 to 1 percent slopes, frequently flooded

Composition

Calco and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats on flood plains
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Alluvium
Flooding: Frequent
Seasonal high water table: At the surface to 1 foot below the surface
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 13.1 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Havelock and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Canisteo Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy, mixed (calcareous), mesic Typic Endoaquolls

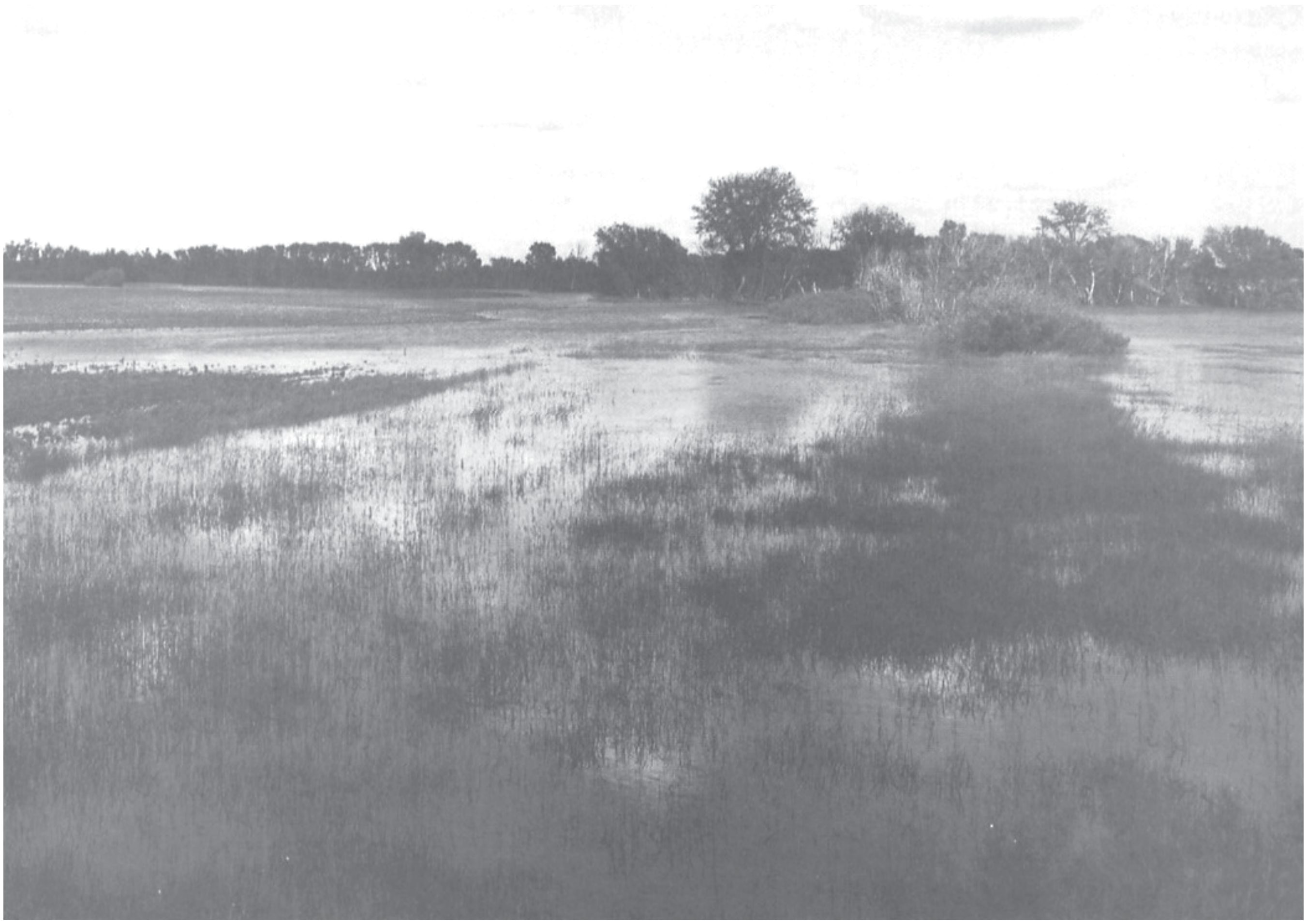

Figure 9.—An area of Calco silty clay loam, 0 to 2 percent slopes, occasionally flooded, during flood stage.

Typical Pedon

Canisteo clay loam, in an area of Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes, 2,550 feet west and 75 feet north of the southeast corner of sec. 22, T. 117 N., R. 31 W.

Ap—0 to 8 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; friable; 1 percent gravel; 1 percent cobbles and stones; slightly effervescent; slightly alkaline; clear smooth boundary.

A—8 to 17 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; 1 percent gravel; 1 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

AB—17 to 23 inches; very dark gray (N 3/0) clay loam, dark gray (N 4/0) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; 2 percent gravel; 2 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg1—23 to 32 inches; dark gray (5Y 4/1) clay loam; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; many very dark gray (5Y 3/1) organic coatings on faces of peds; 2 percent gravel; 2 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg2—32 to 41 inches; olive gray (5Y 5/2) clay loam; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; common fine prominent light olive brown (2.5Y 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 3 percent cobbles and stones;

strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg3—41 to 60 inches; light olive gray (5Y 6/2) loam; weak coarse subangular blocky structure; friable; many medium prominent yellowish brown (10YR 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 3 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 14 to 24 inches

A horizon:
Hue—10YR or neutral
Value—2
Chroma—0 or 1
Texture—clay loam or silty clay loam
Content of rock fragments—1 to 5 percent gravel; 0 to 1 percent cobbles and stones

Bkg horizon, upper part:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam or loam
Content of rock fragments—2 to 4 percent gravel; 2 to 4 percent cobbles and stones

Bkg horizon, lower part:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 to 4
Texture—clay loam or loam
Content of rock fragments—2 to 4 percent gravel; 1 to 4 percent cobbles and stones

86—Canisteo clay loam, moderately fine substratum, 0 to 2 percent slopes

Composition

Canisteo and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Rims of depressions and flats on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.1 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Glencoe and similar soils
- Seaforth and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

956—Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes

Composition

Canisteo and similar soils: About 65 percent
Glencoe and similar soils: About 25 percent
Inclusions: About 10 percent

Setting

Landform: Canisteo—rims of depressions and flats on moraines; Glencoe—depressions on moraines
Slope range: Canisteo—0 to 2 percent; Glencoe—0 to 1 percent

Component Description

Canisteo

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.0 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

Glencoe

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 11.3 inches (high)
Content of organic matter in the surface layer: About 7.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Seaforth and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Chelsea Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Rapid
Landform: Outwash plains and terraces
Parent material: Glacial outwash
Slope range: 1 to 6 percent
Taxonomic classification: Mixed, mesic Argic Udipsamments

Typical Pedon

Chelsea loamy fine sand, 1 to 6 percent slopes, 1,300 feet north and 1,600 feet east of the southwest corner of sec. 11, T. 119 N., R. 30 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loamy fine sand; weak fine subangular blocky structure; very friable; neutral; abrupt smooth boundary.

E—6 to 10 inches; dark brown (10YR 4/3) loamy fine sand; weak very fine subangular blocky structure; very friable; slightly acid; abrupt smooth boundary.

E&Bt—10 to 60 inches; loamy fine sand, brown (10YR 5/3) in the upper part and pale brown (10YR 6/3) in the lower part (E); weak fine subangular blocky structure; very friable; discontinuous bands of dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) fine sandy loam and loamy fine sand $^1/_2$ inch to 2 inches thick; few very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; slightly acid.

Range in Characteristics

Depth to carbonates: Greater than 60 inches

A horizon:
Hue—10YR
Value—3
Chroma—1 to 3
Texture—loamy fine sand

E horizon:
Hue—10YR
Value—4 to 6
Chroma—2 to 6
Texture—fine sand or loamy fine sand

E&Bt horizon (Bt part):
Hue—10YR
Value—3 to 5
Chroma—3 to 6
Texture—loamy fine sand or fine sandy loam

143B—Chelsea loamy fine sand, 1 to 6 percent slopes

Composition

Chelsea and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces
Slope range: 1 to 6 percent

Component Description

Surface layer texture: Loamy fine sand
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.5 inches (low)

Content of organic matter in the surface layer: About 0.75 percent (low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Granby and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Clarion Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 2 to 5 percent
Taxonomic classification: Fine-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Clarion loam, in an area of Clarion-Swanlake complex, 2 to 6 percent slopes, 1,400 feet west and 1,500 feet north of the southeast corner of sec. 24, T. 119 N., R. 32 W.

Ap—0 to 11 inches; black (10YR 2/1) loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure; friable; 1 percent gravel; 1 percent cobbles and stones; neutral; abrupt smooth boundary.

Bw1—11 to 23 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure parting to moderate very fine subangular blocky; friable; very many brown (10YR 4/3) organic coatings on faces of peds and in pores; 1 percent gravel; 2 percent cobbles and stones; slightly acid; gradual smooth boundary.

Bw2—23 to 30 inches; light olive brown (2.5Y 5/4) clay loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; friable; very many brown (10YR 4/3) organic coatings on faces of peds and in pores; 2 percent gravel; 2 percent cobbles and stones; neutral; clear smooth boundary.

Bk—30 to 60 inches; weak coarse subangular blocky structure parting to weak thin platy; friable; light yellowish brown (2.5Y 6/4) loam; few fine prominent olive (5Y 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches
Thickness of the mollic epipedon: 7 to 16 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam
Content of rock fragments—1 to 2 percent gravel; 0 to 1 percent cobbles and stones

Bw horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—loam or clay loam
Content of rock fragments—1 to 4 percent gravel; 1 to 4 percent cobbles and stones

Bk horizon:
Hue—2.5Y
Value—5 or 6
Chroma—4
Texture—loam
Content of rock fragments—3 to 5 percent gravel; 3 to 5 percent cobbles and stones

102B—Clarion loam, moderately fine substratum, 2 to 5 percent slopes

Composition

Clarion and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 2 to 5 percent

Component Description

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.2 inches (high)
Content of organic matter in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

887B—Clarion-Swanlake complex, 2 to 6 percent slopes

Composition

Clarion and similar soils: About 70 percent
Swanlake and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Clarion—summits and backslopes; Swanlake—shoulders and summits
Slope range: Clarion—2 to 5 percent; Swanlake—4 to 6 percent

Component Description

Clarion

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.1 inches (high)
Content of organic matter in the surface layer: About 4.5 percent (high)

Swanlake

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.1 inches (high)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

920B—Clarion-Storden-Hawick complex, 2 to 6 percent slopes

Composition

Clarion and similar soils: About 50 percent
Storden and similar soils: About 20 percent
Hawick and similar soils: About 15 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Clarion—summits and backslopes; Storden and Hawick—shoulders and summits
Slope range: Clarion—2 to 5 percent; Storden—4 to 6 percent; Hawick—2 to 6 percent

Component Description

Clarion

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.2 inches (high)
Content of organic matter in the surface layer: About 4.5 percent (high)

Storden

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

Hawick

Surface layer texture: Gravelly sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.2 inches (low)
Content of organic matter in the surface layer: About 2 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Cohoctah Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately rapid
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 2 percent
Taxonomic classification: Coarse-loamy, mixed, mesic Fluvaquentic Endoaquolls
Taxonomic features: The Cohoctah soil in map unit 1197 has a mollic epipedon more than 24 inches thick.

Typical Pedon

Cohoctah loam, 0 to 2 percent slopes, frequently flooded, 850 feet east and 475 feet south of the northwest corner of sec. 12, T. 120 N., R. 31 W.

A1—0 to 17 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure parting to moderate very fine subangular blocky; very friable; common fine roots; strongly effervescent; slightly alkaline; clear smooth boundary.
A2—17 to 22 inches; very dark gray (5Y 3/1) loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; very friable; few fine prominent olive brown (2.5Y 4/4) iron concentrations; few fine roots; strongly effervescent; slightly alkaline; clear smooth boundary.
Cg—22 to 60 inches; stratified black (10YR 2/1) and dark gray (5Y 3/1 and 4/1) loamy fine sand and gray (5Y 6/1) fine sand; weak very fine subangular blocky structure in the finer textured parts; very friable; common fine prominent dark yellowish brown (10YR 4/6) iron concentrations; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 40 inches
Thickness of the mollic epipedon: 10 to 24 inches

Ap horizon (if it occurs):
  Hue—10YR or neutral
  Value—2 or 3
  Chroma—0 or 1
  Texture—loam or fine sandy loam

A horizon:
  Hue—neutral, 5Y, or 10YR
  Value—2 or 3

Chroma—0 or 1
Texture—fine sandy loam, sandy loam, or loam

Cg horizon:
Hue—5Y, 2.5Y, or 10YR
Value—2 to 6
Chroma—1 or 2
Texture—stratified sand and fine sand and the loamy analogs of these textures; sandy loam, fine sandy loam, and very fine sandy loam; or silt loam that contains less than 20 percent clay
Content of rock fragments—0 to 5 percent gravel; a small amount of shell fragments in some pedons

1163—Cohoctah loam, 0 to 2 percent slopes, frequently flooded

Composition

Cohoctah and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats and swales on flood plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 80 inches
Drainage class: Poorly drained
Dominant parent material: Alluvium
Flooding: Frequent
Seasonal high water table: At the surface to 1 foot below the surface
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 7.4 inches (moderate)
Content of organic matter in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Havelock and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1197—Cohoctah fine sandy loam, 0 to 2 percent slopes, occasionally flooded

Composition

Cohoctah and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on flood plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Fine sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Alluvium
Flooding: Occasional
Seasonal high water table: At the surface to 1 foot below the surface
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.4 inches (high)
Content of organic matter in the surface layer: About 9 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Havelock and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Cokato Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 6 to 12 percent

Taxonomic classification: Fine-loamy, mixed, mesic Typic Argiudolls

Typical Pedon

Cokato loam, in an area of Cokato-Storden complex, 6 to 12 percent slopes, eroded, 1,000 feet east and 1,700 feet north of the southwest corner of sec. 26, T. 118 N., R. 30 W.

A1—0 to 12 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.

A2—12 to 16 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; neutral; clear smooth boundary.

Bt1—16 to 25 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; friable; common very dark brown (10YR 2/2) clay films in pores and on faces of peds; about 2 percent gravel; neutral; clear smooth boundary.

Bt2—25 to 35 inches; light olive brown (2.5Y 5/4) clay loam; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; friable; few very dark grayish brown (10YR 3/2) clay films in pores and on faces of peds; about 2 percent gravel; neutral; clear smooth boundary.

Bt3—35 to 41 inches; light olive brown (2.5Y 5/4) clay loam; moderate coarse subangular blocky structure; friable; few fine distinct light brownish gray (2.5Y 6/2) relict iron depletions; few very dark brown (10YR 2/2) clay films in pores and channels and on faces of peds; about 2 percent gravel; about 1 percent cobbles; neutral; clear wavy boundary.

Bk—41 to 60 inches; light olive brown (2.5Y 5/4) and light yellowish brown (2.5Y 6/3) loam; weak coarse subangular blocky structure; friable; common medium prominent yellowish brown (10YR 5/8) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; about 3 percent gravel; about 1 percent cobbles; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 48 inches
Thickness of the mollic epipedon: 7 to 16 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam
Content of rock fragments—1 to 2 percent gravel; 0 to 1 percent cobbles and stones

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—4
Texture—loam or clay loam
Content of rock fragments—1 to 3 percent gravel; 0 to 4 percent cobbles and stones

Bk horizon:
Hue—2.5Y
Value—5 or 6
Chroma—3 or 4
Texture—loam
Content of rock fragments—3 to 5 percent gravel; 1 to 3 percent cobbles and stones

1213C—Cokato-Storden complex, 6 to 12 percent slopes, eroded

Composition

Cokato and similar soils: About 70 percent
Storden and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Cokato—summits and backslopes; Storden—shoulders and summits
Slope range: 6 to 12 percent

Component Description

Cokato

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.3 inches (high)
Content of organic matter in the surface layer: About 4 percent (high)

Storden

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None

Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hamel and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1220C—Cokato-Storden-Hawick complex, 6 to 12 percent slopes, eroded

Composition

Cokato and similar soils: About 55 percent
Storden and similar soils: About 20 percent
Hawick and similar soils: About 15 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Cokato—summits and backslopes; Storden and Hawick—shoulders and summits
Slope range: 6 to 12 percent

Component Description

Cokato

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.3 inches (high)
Content of organic matter in the surface layer: About 4 percent (high)

Storden

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

Hawick

Surface layer texture: Gravelly sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.3 inches (low)
Content of organic matter in the surface layer: About 2 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hamel and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Collinwood Series

Depth class: Very deep
Drainage class: Moderately well drained and somewhat poorly drained
Permeability: Slow

Landform: Lake plains
Parent material: Lacustrine deposits
Slope range: 0 to 6 percent
Taxonomic classification: Fine, montmorillonitic, mesic Aquertic Hapludolls

Typical Pedon

Collinwood silty clay loam, 3 to 6 percent slopes, 500 feet south and 2,100 feet east of the northwest corner of sec. 24, T. 120 N., R. 30 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine angular blocky structure; firm; slightly acid; clear smooth boundary.
A—8 to 16 inches; very dark grayish brown (2.5Y 3/2) and very dark brown (10YR 2/2) silty clay; strong fine angular blocky structure parting to strong very fine angular blocky; firm; slightly acid; clear smooth boundary.
Bw1—16 to 24 inches; dark grayish brown (2.5Y 4/2) and very dark grayish brown (2.5Y 3/2) silty clay; strong fine prismatic structure parting to moderate very fine angular blocky; firm; neutral; clear smooth boundary.
Bw2—24 to 32 inches; light olive brown (2.5Y 5/4) and olive brown (2.5Y 4/4) silty clay loam; moderate medium prismatic structure parting to moderate very fine angular blocky; firm; few fine faint grayish brown (2.5Y 5/2) iron depletions; neutral; clear smooth boundary.
C1—32 to 38 inches; light yellowish brown (2.5Y 6/4) silty clay loam; weak coarse prismatic structure parting to moderate coarse subangular blocky; friable; few fine distinct olive yellow (2.5Y 6/6) iron concentrations and few light brownish gray (2.5Y 6/2) iron depletions; strongly effervescent; slightly alkaline; clear smooth boundary.
C2—38 to 60 inches; light yellowish brown (2.5Y 6/4), stratified silty clay loam and silt loam; weak coarse subangular blocky structure parting to weak thin platy; friable; few fine distinct olive yellow (2.5Y 6/6) iron concentrations and few light brownish gray (2.5Y 6/2) iron depletions; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 24 to 46 inches
Thickness of the mollic epipedon: 14 to 24 inches
Other features: In some pedons the C horizon consists of alternating strata of silty clay and silty clay loam and silt loam.

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—silty clay loam

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—silty clay, clay, or silty clay loam (content of clay averages 35 to 55 percent)

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—silty clay, clay, or silty clay loam

96B—Collinwood silty clay loam, 3 to 6 percent slopes

Composition

Collinwood and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Lake plains
Position on the landform: Summits and backslopes
Slope range: 3 to 6 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.4 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Waldorf and similar soils
- Lura and similar soils

Major Uses of the Unit

- Cropland

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1387A—Collinwood silty clay loam, moderately wet, 0 to 3 percent slopes

Composition

Collinwood and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Slight rises on lake plains
Slope range: 0 to 3 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: 1.5 to 2.5 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 8.4 inches (moderate)
Content of organic matter in the surface layer: About 6.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Waldorf and similar soils
- Rolfe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Cordova Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy, mixed, mesic Typic Argiaquolls

Typical Pedon

Cordova clay loam, in an area of Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes, 1,525 feet north and 1,150 feet east of the southwest corner of sec. 1, T. 118 N., R. 29 W.

Ap—0 to 11 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine angular blocky structure; friable; slightly acid; clear smooth boundary.
AE—11 to 15 inches; very dark gray (N 3/0) clay loam, gray (N 5/0) dry; moderate fine angular blocky structure; friable; common white (10YR 8/2) sand coatings on faces of peds and in pores; 1 percent gravel; slightly acid; clear smooth boundary.
Btg1—15 to 24 inches; olive gray (5Y 4/2) clay loam; moderate fine prismatic structure; firm; common very dark grayish brown (2.5Y 3/2) clay films on faces of peds; common white (10YR 8/2) sand coatings on faces of peds and in pores; 1 percent gravel; slightly acid; clear smooth boundary.
Btg2—24 to 33 inches; olive gray (5Y 5/2) clay loam; moderate medium prismatic structure parting to moderate medium angular blocky; firm; common fine distinct olive (5Y 5/6) iron concentrations; common black (N 2/0) clay films on faces of peds; 2 percent gravel; slightly acid; clear smooth boundary.
Btg3—33 to 39 inches; light olive gray (5Y 6/2) clay loam; weak coarse prismatic structure parting to weak coarse subangular blocky; firm; common fine distinct olive (5Y 5/6) iron concentrations; common black (N 2/0) clay films on faces of peds; 2 percent gravel; 1 percent cobbles and stones; neutral; clear smooth boundary.
Bkg—39 to 60 inches; light olive gray (5Y 6/2) loam; weak coarse subangular blocky structure parting to weak medium platy; firm; many medium distinct olive (5Y 5/6) iron concentrations; common black (N 2/0) clay films on faces of peds; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 2 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 50 inches
Thickness of the mollic epipedon: 10 to 24 inches

A horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—clay loam
Content of rock fragments—0 to 2 percent gravel; 0 to 2 percent cobbles and stones

Btg horizon:
Hue—5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam or clay loam
Content of rock fragments—1 to 4 percent gravel; 1 to 3 percent cobbles and stones

Bkg horizon:
Hue—5Y
Value—5 or 6
Chroma—2
Texture—loam or clay loam
Content of rock fragments—2 to 4 percent gravel; 2 to 4 percent cobbles and stones

978—Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes

Composition

Cordova and similar soils: About 60 percent
Rolfe and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Cordova—drainageways and flats; Rolfe—depressions
Slope range: Cordova—0 to 2 percent; Rolfe—0 to 1 percent

Component Description

Cordova

Surface layer texture: Clay loam
Depth to bedrock: Greater than 80 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.2 inches (high)
Content of organic matter in the surface layer: About 5.5 percent (high)

Rolfe

Surface layer texture: Silt loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: 1 foot above to 1 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 10.9 inches (high)
Content of organic matter in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Corvuso Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Moraines
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 2 percent
Taxonomic classification: Fine, mesic Typic Calciaquolls

Typical Pedon

Corvuso clay loam, in an area of Corvuso-Lura, depressional, complex, 0 to 2 percent slopes, 2,200 feet west and 50 feet south of the northeast corner of sec. 34, T. 117 N., R. 32 W.

Ap—0 to 8 inches; black (N 2/0) clay loam, black (N 2/0) dry; weak fine angular blocky structure;

friable; about 1 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

Ak—8 to 11 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; moderate fine angular blocky structure parting to moderate very fine angular blocky; friable; carbonates disseminated throughout; about 1 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

Bkg1—11 to 15 inches; gray (5Y 5/1) clay; moderate medium angular blocky structure parting to moderate very fine angular blocky; firm; common threads and masses of calcium carbonate disseminated throughout; about 1 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

Bkg2—15 to 28 inches; olive gray (5Y 5/2) clay; moderate medium angular blocky structure parting to moderate fine angular blocky; firm; common medium prominent light olive brown (2.5Y 5/6) iron concentrations; common threads and masses of calcium carbonate disseminated throughout; 2 percent gravel; violently effervescent; moderately alkaline; gradual wavy boundary.

2BCg—28 to 60 inches; olive gray (5Y 5/2) clay loam; weak medium prismatic structure parting to weak fine angular blocky; very firm; many medium prominent light olive brown (2.5Y 5/6) iron concentrations; few threads and masses of calcium carbonate; 3 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Carbonates: At the surface
Thickness of the mollic epipedon: 12 to 24 inches
Thickness of lacustrine deposits: 15 to 60 inches

Ap horizon:
Hue—10YR or neutral
Value—2
Chroma—0 or 1
Texture—clay loam or silty clay loam
Content of rock fragments—0 to 1 percent gravel

Ak horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—silty clay, silty clay loam, or clay loam
Content of rock fragments—0 to 1 percent gravel

Bkg horizon:
Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay loam, silty clay, or clay
Content of rock fragments—0 to 4 percent gravel; 0 to 2 percent cobbles and stones

2BCg horizon:
Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam, silty clay, or clay
Content of rock fragments—1 to 4 percent gravel; 1 to 2 percent cobbles and stones

1169—Corvuso-Lura, depressional, complex, 0 to 2 percent slopes

Composition

Corvuso and similar soils: About 60 percent
Lura and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Corvuso—rims of depressions and flats; Lura—depressions (fig. 10)
Slope range: Corvuso—0 to 2 percent; Lura—0 to 1 percent

Component Description

Corvuso

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 8.9 inches (moderate)
Content of organic matter in the surface layer: About 5.5 percent (high)

Lura

Surface layer texture: Silty clay
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Lacustrine deposits
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long

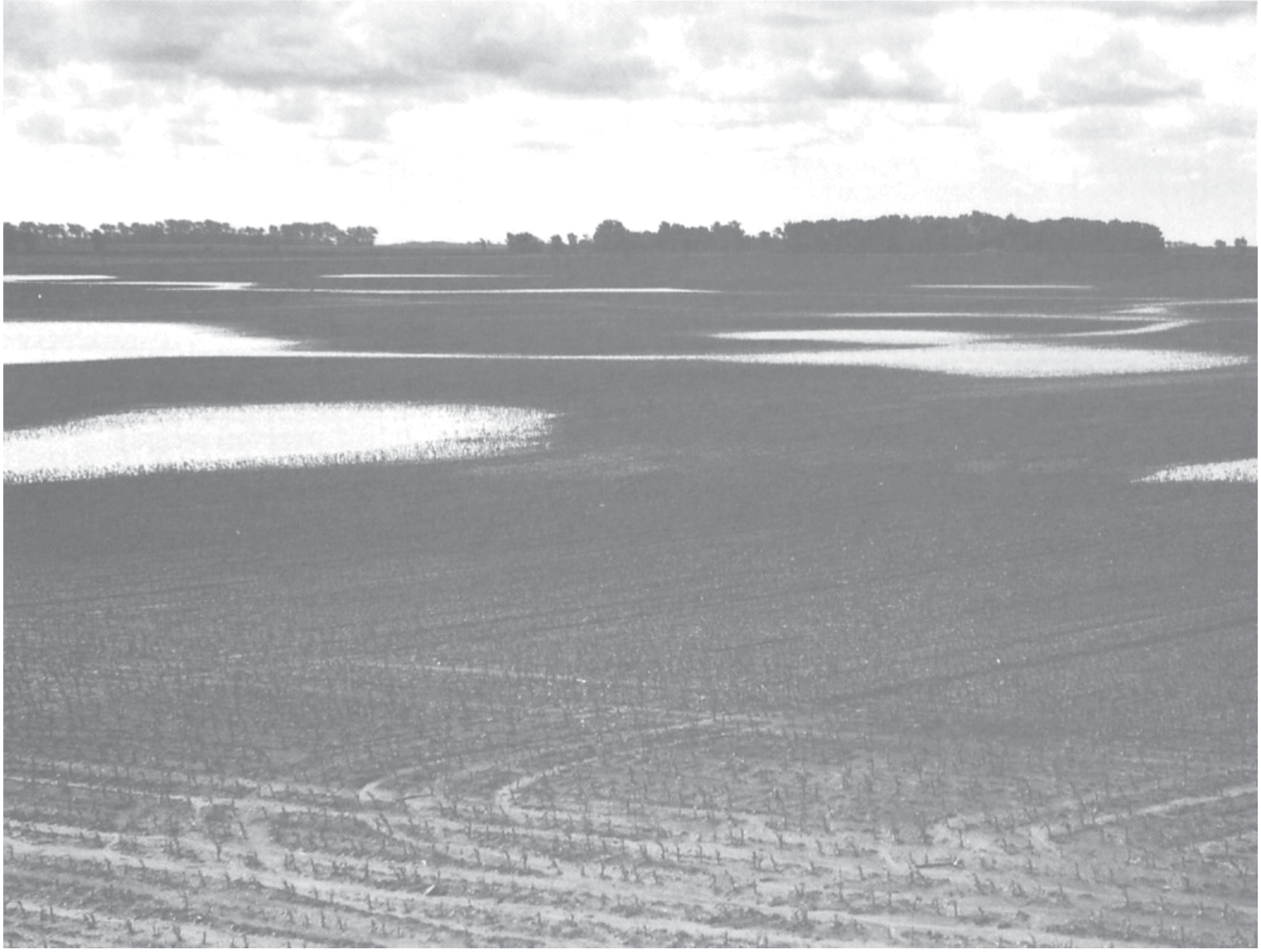

Figure 10.—The soil in the ponded areas in this field is the Lura component of Corvuso-Lura, depressional, complex, 0 to 2 percent slopes. The ponding reduces crop yields in areas of this map unit.

Available water capacity to 60 inches or root-limiting layer: About 9.3 inches (high)
Content of organic matter in the surface layer: About 8 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Kandiyohi and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1184—Corvuso silty clay loam, 0 to 2 percent slopes

Composition

Corvuso and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Rims of depressions and flats on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 8.6 inches (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cosmos and similar soils
- Lura and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Cosmos Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Moraines
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 2 percent
Taxonomic classification: Fine, montmorillonitic, mesic Vertic Epiaquolls

Typical Pedon

Cosmos silty clay, 0 to 2 percent slopes (fig. 11), 425 feet east and 110 feet north of the southwest corner of sec. 23, T. 117 N., R. 32 W.

Ap—0 to 7 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; weak fine angular blocky structure parting to strong very fine angular blocky; friable; neutral; abrupt smooth boundary.

A—7 to 15 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; strong fine angular blocky structure parting to strong very fine angular blocky; friable; neutral; clear smooth boundary.

ABg—15 to 20 inches; very dark gray (10YR 3/1) silty clay, dark gray (N 4/0) dry; strong medium angular blocky structure parting to strong very fine angular blocky; friable; neutral; clear smooth boundary.

Btg—20 to 30 inches; olive gray (5Y 5/2) silty clay; weak coarse prismatic structure parting to strong very fine angular blocky; firm; common olive gray (5Y 4/2) clay films on faces of peds; few light gray or gray (10YR 6/1) crystals of gypsum; neutral; clear broken boundary.

Btkg—30 to 36 inches; olive gray (5Y 5/2) silty clay; moderate very coarse prismatic structure parting to strong fine angular blocky; firm; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; many olive gray (5Y 4/2) stress surfaces on faces of peds; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline; clear broken boundary.

2Bkg—36 to 60 inches; olive gray (5Y 5/2) clay loam; moderate fine angular blocky structure; firm; many medium prominent dark yellowish brown (10YR 4/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; many stress surfaces on faces of peds; 3 percent gravel; 3 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Thickness of lacustrine sediment: 24 to 40 inches
Thickness of the mollic epipedon: 14 to 24 inches

A horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—silty clay
Content of rock fragments—0 to 1 percent gravel

Btg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay, clay, or silty clay loam
Content of rock fragments—0 to 1 percent gravel

Btkg horizon:
Hue—2.5Y or 5Y
Chroma—5 or 6
Value—2
Texture—silty clay, clay, or silty clay loam
Content of rock fragments—0 to 1 percent gravel; 0 to 1 percent cobbles

2Bkg horizon:
Hue—5Y
Value—5 or 6
Chroma—2
Texture—silty clay, clay, silty clay loam, or clay loam
Content of rock fragments—2 to 4 percent gravel; 1 to 3 percent cobbles and stones

1193—Cosmos silty clay, 0 to 2 percent slopes

Composition

Cosmos and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lura and similar soils
- Corvuso and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Crowriver Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately rapid
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Coarse-loamy, mesic Typic Calciaquolls

Typical Pedon

Crowriver fine sandy loam, in an area of Crowriver-Lundlake, depressional, complex, 0 to 2 percent slopes, 200 feet south and 1,100 feet west of the northeast corner of sec. 29, T. 121 N., R. 32 W.

Apk—0 to 9 inches; black (N 2/0) fine sandy loam, gray (10YR 5/1) dry; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; secondary lime disseminated throughout; 1 percent gravel; 3 percent cobbles; violently effervescent; slightly alkaline; clear smooth boundary.

Ak—9 to 13 inches; black (N 2/0) fine sandy loam, gray (10YR 5/1) dry; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; secondary lime disseminated throughout; 1 percent gravel; 3 percent cobbles; violently effervescent; slightly alkaline; clear smooth boundary.

ABk—13 to 17 inches; dark gray (10YR 4/1) fine sandy loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; few light olive gray (5Y 6/2) carbonate coatings on faces of peds; 2 percent gravel; 4 percent cobbles; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg1—17 to 29 inches; light olive gray (5Y 6/2) fine sandy loam; weak medium subangular blocky structure; very friable; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 6 percent cobbles; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg2—29 to 45 inches; light olive gray (5Y 6/2) fine sandy loam; weak medium subangular blocky structure; very friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; about 3 percent gravel; 8 percent cobbles; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg3—45 to 60 inches; light olive gray (5Y 6/2) fine sandy loam; weak coarse subangular blocky structure parting to weak thin platy; very friable; many medium prominent yellowish brown (10YR 5/8) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 4 percent gravel; 8 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface
Thickness of the mollic epipedon: 10 to 16 inches

Ak horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—fine sandy loam or loam
Content of rock fragments—1 to 3 percent gravel; 1 to 3 percent cobbles and stones

Bkg horizon, upper part:
Hue—2.5Y, 5Y, or 10YR
Value—4 to 6
Chroma—1 or 2
Texture—loam, fine sandy loam, sandy loam, or sandy clay loam
Content of rock fragments—3 to 7 percent gravel; 3 to 6 percent cobbles and stones

Bkg horizon, lower part:
Hue—5Y or 2.5Y
Value—5 or 6
Chroma—2 or 3
Texture—fine sandy loam, sandy loam, or loam high in sand
Content of rock fragments—3 to 8 percent gravel; 3 to 8 percent cobbles and stones

1183—Crowriver loam, 0 to 2 percent slopes

Composition

Crowriver and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Rims of depressions and flats on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.4 inches (moderate)
Content of organic matter in the surface layer: About 5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lundlake and similar soils
- Swedegrove and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1192—Crowriver-Lundlake, depressional, complex, 0 to 2 percent slopes

Composition

Crowriver and similar soils: About 70 percent
Lundlake and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Crowriver—rims of depressions and flats; Lundlake—depressions
Slope range: Crowriver—0 to 2 percent; Lundlake—0 to 1 percent

Component Description

Crowriver

Surface layer texture: Fine sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till

Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.2 inches (moderate)
Content of organic matter in the surface layer: About 5 percent (high)

Lundlake

Surface layer texture: Loam
Depth to bedrock: Greater than 80 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 9.8 inches (high)
Content of organic matter in the surface layer: About 8.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Uniongrove and similar soils
- Grovecity and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Cylinder Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate in the loamy mantle and very rapid in the underlying sand and gravel
Landform: Outwash plains and terraces
Parent material: Glacial outwash
Slope range: 0 to 1 percent
Taxonomic classification: Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquic Hapludolls

Typical Pedon

Cylinder loam, 0 to 1 percent slopes, 1,500 feet north and 1,600 feet west of the southeast corner of sec. 8, T. 119 N., R. 31 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; 1 percent gravel; slightly acid; clear smooth boundary.

A—10 to 15 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; 1 percent gravel; slightly acid; clear smooth boundary.

Bw1—15 to 31 inches; dark grayish brown (2.5Y 4/2) loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; common fine distinct olive brown (2.5Y 4/4) iron concentrations; 1 percent gravel; slightly acid; clear smooth boundary.

2Bw2—31 to 40 inches; light brownish gray (2.5Y 6/2) gravelly sand; single grain; loose; many medium distinct light olive brown (2.5Y 5/6) and common yellowish brown (10YR 5/6) iron concentrations; 20 percent gravel; neutral; clear smooth boundary.

2Bk—40 to 60 inches; light brownish gray (2.5Y 6/2) gravelly sand; single grain; loose; 20 percent gravel; common soft white (10YR 8/2) accumulations of calcium carbonate on the underside of pebbles and fragments of very coarse sand; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 48 inches
Thickness of the loamy mantle: 24 to 40 inches
Thickness of the mollic epipedon: 14 to 24 inches

A horizon:
Hue—10YR
Value—2
Chroma—1 or 2
Texture—loam
Content of rock fragments—0 to 1 percent

Bw horizon:
Hue—2.5Y or 10YR
Value—4 or 5
Chroma—2
Texture—loam
Content of rock fragments—0 to 2 percent gravel

2Bk horizon:
Hue—2.5Y
Value—3 to 6

Chroma—2 to 6
Texture—stratified sand, coarse sand, or the gravelly or very gravelly analogs of these textures
Content of rock fragments—0 to 50 percent gravel

129—Cylinder loam, 0 to 1 percent slopes

Composition

Cylinder and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 2 to 4 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 6.9 inches (moderate)
Content of organic matter in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Wadena and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Danielson Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Moraines
Parent material: Colluvium over till
Slope range: 1 to 3 percent
Taxonomic classification: Fine, montmorillonitic, mesic Cumulic Vertic Epiaquolls

Typical Pedon

Danielson clay loam, 1 to 3 percent slopes, 1,700 feet south and 400 feet west of the northeast corner of sec. 14, T. 118 N., R. 32 W.

Ap—0 to 9 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine angular blocky clods; friable; neutral; clear smooth boundary.
A1—9 to 19 inches; black (N 2/0) silty clay, very dark gray (N 2/0) dry; moderate very fine angular blocky structure; friable; neutral; gradual smooth boundary.
A2—19 to 31 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; moderate fine angular blocky structure parting to strong very fine angular blocky; friable; neutral; clear smooth boundary.
AB—31 to 36 inches; very dark gray (N 3/0) silty clay, dark gray (N 4/0) dry; strong fine angular blocky structure parting to strong very fine angular blocky; firm; neutral; clear smooth boundary.
Bg1—36 to 51 inches; dark gray (5Y 4/1) silty clay; moderate medium prismatic structure parting to strong fine angular blocky; firm; neutral; clear smooth boundary.
2Bg2—51 to 60 inches; strong medium prismatic structure parting to strong fine angular blocky; firm; olive gray (5Y 5/2) silty clay loam; common fine prominent light olive brown (2.5Y 5/6) iron concentrations; neutral; about 1 percent gravel; about 1 percent cobbles and stones.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches
Thickness of the mollic epipedon: 24 to more than 60 inches

Ap horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—clay loam or silty clay loam

A horizons:
Hue—neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam, silty clay, or silty clay loam

Bg horizon:
Hue—5Y

Value—4 or 5
Chroma—1 or 2
Texture—silty clay, clay, or silty clay loam
Content of rock fragments—0 to 1 percent gravel

2Bg or 2BC horizon (if it occurs):
Hue—5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay, silty clay loam, clay, or clay loam
Content of rock fragments—1 to 5 percent gravel; 2 to 4 percent cobbles and stones

1174—Danielson clay loam, 1 to 3 percent slopes

Composition

Danielson and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Drainageways on moraines
Slope range: 1 to 3 percent

Component Description

Surface layer texture: Clay loam
Depth to bedrock: Greater than 80 inches
Drainage class: Poorly drained
Dominant parent material: Colluvium over till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)
Content of organic matter in the surface layer: About 7.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lura and similar soils
- Strout and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Darfur Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately rapid
Landform: Outwash plains
Parent material: Glaciolacustrine deposits or glacial outwash
Slope range: 0 to 2 percent
Taxonomic classification: Coarse-loamy, mixed, mesic Typic Endoaquolls

Typical Pedon

Darfur loam, 0 to 2 percent slopes, 1,450 feet south and 150 feet west of the northeast corner of sec. 1, T. 119 N., R. 31 W.

Ap—0 to 10 inches; black (N 2/0) loam, black (10YR 2/1) dry; weak very fine subangular blocky structure; very friable; neutral; clear smooth boundary.

A—10 to 19 inches; black (N 2/0) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; very friable; neutral; clear smooth boundary.

AB—19 to 23 inches; very dark grayish brown (10YR 3/2) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; very many very dark gray (10YR 3/1) organic coatings on faces of peds; neutral; clear smooth boundary.

Bg1—23 to 30 inches; olive gray (5Y 4/2) very fine sandy loam; weak fine subangular blocky structure; very friable; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; neutral; clear smooth boundary.

Bg2—30 to 39 inches; olive gray (5Y 5/2) loamy very fine sand; weak fine subangular blocky structure; very friable; few fine prominent yellowish brown (10YR 5/6) iron concentrations; neutral; clear smooth boundary.

Cg—39 to 60 inches; olive gray (5Y 5/2) very fine sand; single grain; loose; few fine distinct olive (5Y 5/4) iron concentrations; neutral.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches
Thickness of the mollic epipedon: 14 to 24 inches

Ap horizon:
Hue—10YR or neutral
Value—2 or 3

Chroma—0 or 1
Texture—loam

A horizons:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loam or very fine sandy loam

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam, very fine sandy loam, or fine sandy loam or stratified with fine sand, fine sandy loam, very fine sand, very fine sandy loam, sand, or sandy loam

Cg horizon:
Hue—5Y
Value—5 or 6
Chroma—1 or 2
Texture—fine sand, loamy fine sand, very fine sand, or loamy very fine sand or stratified with sandy loam, fine sandy loam, very fine sandy loam, or loam

281—Darfur loam, 0 to 2 percent slopes

Composition

Darfur and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on outwash plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits or glacial outwash
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.7 inches (moderate)
Content of organic matter in the surface layer: About 6.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Dassel and similar soils
- Litchfield and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Dassel Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate or moderately rapid in the upper mantle; rapid in the lower part of the subsoil and in the underlying material
Landform: Deltas, outwash plains, and terraces
Parent material: Glaciolacustrine deposits or glacial outwash
Slope range: 0 to 1 percent
Taxonomic classification: Coarse-loamy, mixed, mesic Typic Endoaquolls

Typical Pedon

Dassel mucky fine sandy loam, depressional, 0 to 1 percent slopes, 2,425 feet north and 1,875 feet east of the southwest corner of sec. 13, T. 121 N., R. 31 W.

Ap—0 to 6 inches; black (N 2/0) mucky fine sandy loam, very dark gray (N 3/0) dry; weak very fine subangular blocky structure; very friable; common fine prominent gray (5Y 6/1) iron depletions; slightly acid; clear smooth boundary.
A1—6 to 14 inches; black (N 2/0) very fine sandy loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; very friable; common fine prominent dark brown (7.5YR 4/4) iron concentrations; slightly acid; clear smooth boundary.
A2—14 to 23 inches; very dark gray (10YR 3/1) very fine sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.
Bgw—23 to 31 inches; olive gray (5Y 5/2) loamy very fine sand; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.
Cg—31 to 60 inches; olive gray (5Y 5/2) fine sand; single grain; loose; slightly acid.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches
Thickness of the mollic epipedon: 10 to 24 inches

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—mucky fine sandy loam, loam, or fine sandy loam

Bg horizon:
Hue—5Y
Value—4 or 5
Chroma—1 or 2
Texture—dominantly stratified loamy very fine sand, very fine sandy loam, or fine sandy loam; subhorizons that are dominantly fine sand, loamy fine sand, or fine sandy loam or the very fine sand and medium sand analogs of these textures in some pedons

Cg horizon:
Hue—5Y, 5GY, 5G, or 5BG
Value—4 to 6
Chroma—1 or 2
Texture—fine sand, loamy fine sand, very fine sand, or loamy very fine sand or stratified; subhorizons that are dominantly fine sand, loamy fine sand, or fine sandy loam or the very fine sand and medium sand analogs of these textures in stratified pedons

183—Dassel mucky fine sandy loam, depressional, 0 to 1 percent slopes

Composition

Dassel and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Depressions on outwash plains and deltas
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Mucky fine sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Glaciolacustrine deposits or glacial outwash
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 8.6 inches (moderate)
Content of organic matter in the surface layer: About 11.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Litchfield and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Dickman Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Rapid
Landform: Outwash plains and terraces
Parent material: Glacial outwash
Slope range: 0 to 6 percent
Taxonomic classification: Sandy, mixed, mesic Typic Hapludolls

Typical Pedon

Dickman sandy loam, 0 to 2 percent slopes, 2,450 feet north and 1,800 feet east of the southwest corner of sec. 12, T. 120 N., R. 31 W.

Ap—0 to 12 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; very friable; 1 percent gravel; moderately acid; clear smooth boundary.

AB—12 to 15 inches; dark brown (10YR 3/3) sandy loam; weak very fine subangular blocky structure; very friable; common very dark grayish brown (10YR 3/2) organic coatings on faces of peds; 1 percent gravel; slightly acid; clear smooth boundary.

Bw1—15 to 18 inches; dark brown (10YR 4/3) sandy loam; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; common dark brown (10YR 3/3) organic coatings on faces of peds; 1 percent gravel; slightly acid; clear smooth boundary.

2Bw2—18 to 25 inches; dark brown (10YR 4/3) loamy sand; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; few dark brown (10YR 3/3) organic coatings on faces of peds; 10 percent gravel; slightly acid; clear smooth boundary.

2BC—25 to 36 inches; dark brown (10YR 4/3) sand; weak fine subangular blocky structure; very friable; 10 percent gravel; neutral; abrupt smooth boundary.

2C—36 to 60 inches; light brownish gray (2.5Y 6/2) sand; single grain; loose; 10 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: Greater than 30 inches
Thickness of the loamy mantle: 12 to 20 inches
Thickness of the mollic epipedon: 10 to 20 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam
Content of rock fragments—0 to 5 percent gravel

Bw horizon:
Hue—7.5YR or 10YR
Value—3 or 4
Chroma—3 or 4
Texture—sandy loam or fine sandy loam
Content of rock fragments—0 to 10 percent gravel

2Bw horizon:
Hue—7.5YR or 10YR
Value—4 to 6
Chroma—2 to 4
Texture—loamy sand, fine sand, sand, or coarse sand
Content of rock fragments—0 to 15 percent gravel

2C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—coarse sand, sand, or fine sand
Content of rock fragments—0 to 15 percent gravel

327A—Dickman sandy loam, 0 to 2 percent slopes

Composition

Dickman and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.4 inches (low)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Litchfield and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

327B—Dickman sandy loam, 2 to 6 percent slopes

Composition

Dickman and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces
Slope range: 2 to 6 percent

Component Description

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat excessively drained

Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.4 inches (low)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Litchfield and similar soils
- Darfur and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Estherville Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Moderately rapid in the loamy mantle and very rapid in the underlying sand and gravel
Landform: Outwash plains and terraces
Parent material: Glacial outwash
Slope range: 0 to 12 percent
Taxonomic classification: Sandy, mixed, mesic Typic Hapludolls
Taxadjunct features: The Estherville soil in map unit 875C is shallower to carbonates (13 inches) than is defined as the range for the series.

Typical Pedon

Estherville sandy loam, 0 to 2 percent slopes, 1,500 feet west and 200 feet north of the southeast corner of sec. 31, T. 121 N., R. 31 W.

Ap—0 to 6 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; very friable; few fine roots; 2 percent gravel; neutral; clear smooth boundary.

A—6 to 12 inches; very dark brown (10YR 2/2) sandy loam, very dark grayish brown (10YR 3/2) dry; moderate medium subangular blocky structure; very friable; 2 percent gravel; neutral; clear smooth boundary.

Bw1—12 to 15 inches; dark brown (10YR 3/3) sandy loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; very friable; 5 percent gravel; slightly acid; abrupt wavy boundary.

2Bw2—15 to 27 inches; dark brown (10YR 4/3) sand; weak medium subangular blocky structure; loose; 10 percent gravel; neutral; abrupt smooth boundary.

2Bk1—27 to 38 inches; grayish brown (10YR 5/2) gravelly coarse sand; single grain; loose; 25 percent gravel (common shale fragments); common soft white (10YR 8/2) accumulations of calcium carbonate on underside of gravel and very coarse sand fragments; strongly effervescent; slightly alkaline; clear smooth boundary.

2Bk2—38 to 60 inches; dark brown (7.5YR 4/4) gravelly coarse sand; single grain; loose; 20 percent gravel; common soft white (10YR 8/2) accumulations of calcium carbonate on underside of gravel and very coarse sand fragments; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 15 to 30 inches
Thickness of the loamy mantle: 12 to 20 inches
Thickness of the mollic epipedon: 8 to 18 inches

A horizon:
Hue—10YR
Value—2
Chroma—1 or 2
Texture—sandy loam
Content of rock fragments—0 to 5 percent gravel

Bw horizon:
Hue—10YR or 7.5YR
Value—3 or 4
Chroma—3 or 4
Texture—sandy loam or coarse sandy loam
Content of rock fragments—2 to 10 percent gravel

2Bw and 2Bk horizons:
Hue—10YR or 7.5YR
Value—4 or 5
Chroma—2 to 4
Texture—sand, coarse sand, or gravelly coarse sand
Content of rock fragments—15 to 35 percent gravel

41A—Estherville sandy loam, 0 to 2 percent slopes

Composition

Estherville and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.7 inches (low)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

875B—Estherville-Hawick complex, 2 to 6 percent slopes

Composition

Estherville and similar soils: About 60 percent
Hawick and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Estherville

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.6 inches (low)
Content of organic matter in the surface layer: About 3 percent (moderate)

Hawick

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.2 inches (low)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Fieldon Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate or moderately rapid in the upper mantle; rapid in the lower part of the subsoil and in the underlying material
Landform: Deltas and outwash plains
Parent material: Glaciolacustrine deposits or glacial outwash
Slope range: 0 to 2 percent

Taxonomic classification: Coarse-loamy, mixed (calcareous), mesic Typic Endoaquolls

Typical Pedon

Fieldon loam, in an area of Fieldon-Dassel, depressional, complex, 0 to 2 percent slopes, 2,000 feet north and 2,000 feet west of the southeast corner of sec. 1, T. 119 N., R. 31 W.

Ap—0 to 10 inches; black (N 2/0) loam; weak fine subangular blocky structure; very friable; strongly effervescent; moderately alkaline; clear smooth boundary.

A—10 to 14 inches; very dark gray (10YR 3/1) loam; weak fine subangular blocky structure; very friable; violently effervescent; moderately alkaline; clear smooth boundary.

Bg—14 to 20 inches; dark gray (10YR 4/1) loam; weak fine subangular blocky structure; very friable; violently effervescent; moderately alkaline; clear smooth boundary.

Cg1—20 to 26 inches; light olive gray (5Y 6/2) very fine sandy loam; weak fine subangular blocky structure; very friable; strongly effervescent; moderately alkaline; clear smooth boundary.

Cg2—26 to 32 inches; light olive gray (5Y 6/2) loamy very fine sand; weak medium subangular blocky structure; very friable; strongly effervescent; slightly alkaline; clear smooth boundary.

Cg3—32 to 60 inches; stratified, light olive gray (5Y 6/2) and gray (5Y 6/1) loamy very fine sand and fine sand; weak fine subangular blocky structure; very friable; common medium prominent yellowish brown (10YR 5/6) iron concentrations; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface
Thickness of the mollic epipedon: 14 to 24 inches

Ap horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—loam

A horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—loam or fine sandy loam

Bg horizon:
Hue—5Y to 10YR
Value—4 to 6
Chroma—1 or 2
Texture—stratified silt loam, loam, very fine sandy loam, loamy very fine sand, or loamy fine sand

Cg horizon:
Hue—5Y
Value—5 or 6
Chroma—1 or 2
Texture—stratified fine sand, loamy fine sand, fine sandy loam, or the very fine sand analogs of these textures

1096—Fieldon-Dassel, depressional, complex, 0 to 2 percent slopes

Composition

Fieldon and similar soils: About 70 percent
Dassel and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains and deltas
Position on the landform: Fieldon—flats and drainageways; Dassel—depressions
Slope range: Fieldon—0 to 2 percent; Dassel—0 to 1 percent

Component Description

Fieldon

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glaciolacustrine deposits or glacial outwash
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 6.8 inches (moderate)
Content of organic matter in the surface layer: About 6.5 percent (high)

Dassel

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Glaciolacustrine deposits or glacial outwash
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long

Available water capacity to 60 inches or root-limiting layer: About 8.5 inches (moderate)
Content of organic matter in the surface layer: About 11.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Litchfield and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Forestcity Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Local alluvium over till
Slope range: 0 to 3 percent
Taxonomic classification: Fine-loamy, mixed, mesic Typic Argiaquolls

Typical Pedon

Forestcity fine sandy loam, in an area of Forestcity-Lundlake, depressional, complex, 0 to 3 percent slopes, 2,550 feet east and 2,550 feet south of the northwest corner of sec. 34, T. 121 N., R. 29 W.

Ap—0 to 10 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.

A1—10 to 22 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; slightly acid; clear smooth boundary.

A2—22 to 36 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate very fine subangular blocky; very friable; black (N 2/0) coatings of organic matter on many ped faces; about 1 percent gravel; slightly acid; gradual smooth boundary.

AB—36 to 43 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine prismatic structure parting to moderate fine angular blocky; friable; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; about 2 percent gravel; slightly acid; clear smooth boundary.

2Btg1—43 to 48 inches; olive gray (5Y 4/2) sandy clay loam; moderate medium prismatic structure parting to moderate fine angular blocky; firm; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; many very dark gray (10YR 3/1) clay films on faces of peds and in pores; about 4 percent gravel; about 1 percent cobbles; moderately acid; gradual smooth boundary.

2Btg2—48 to 60 inches; olive gray (5Y 5/2) sandy clay loam; moderate coarse prismatic structure parting to moderate coarse angular blocky; friable; common fine distinct light olive brown (2.5Y 5/4) iron concentrations; very many very dark gray (10YR 3/1) clay films on faces of peds and in pores; few fine faint light gray (5Y 6/1) iron depletions; about 6 percent gravel; about 2 percent cobbles; slightly acid; clear smooth boundary.

2Btg3—60 to 65 inches; light olive gray (5Y 6/2) sandy loam; weak coarse prismatic structure parting to weak coarse subangular blocky; very friable; common fine distinct light olive brown (2.5Y 5/6) iron concentrations; common very dark gray (10YR 3/1) clay films on faces of peds; about 6 percent gravel; about 3 percent cobbles; very slightly effervescent; neutral.

Range in Characteristics

Depth to carbonates: 30 to more than 60 inches
Thickness of the mollic epipedon: 24 to 54 inches
Other features: Some pedons have a 2Bg or 2Bkg horizon.

Ap or A1 horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—fine sandy loam
Content of rock fragments—0 to 2 percent gravel; 0 to 2 percent cobbles and stones

A2 horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 to 2
Texture—loam, sandy clay loam, or clay loam

Content of rock fragments—0 to 2 percent gravel; 0 to 2 percent cobbles and stones

2Btg horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 5
Chroma—1 or 2
Texture—loam, sandy clay loam, or clay loam
Content of rock fragments—2 to 6 percent gravel; 2 to 4 percent cobbles and stones

1186—Forestcity-Lundlake, depressional, complex, 0 to 3 percent slopes

Composition

Forestcity and similar soils: About 80 percent
Lundlake and similar soils: About 15 percent
Inclusions: About 5 percent

Setting

Landform: Moraines
Position on the landform: Forestcity—drainageways; Lundlake—depressions
Slope range: Forestcity—0 to 3 percent; Lundlake—0 to 1 percent

Component Description

Forestcity

Surface layer texture: Fine sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Local alluvium over glacial till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.8 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

Lundlake

Surface layer texture: Loam
Depth to bedrock: Greater than 80 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 10.3 inches (high)
Content of organic matter in the surface layer: About 8.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Koronis and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Gardencity Series

Depth class: Very deep
Drainage class: Well drained and moderately well drained
Permeability: Moderately rapid
Landform: Lake plains and outwash plains
Parent material: Glaciolacustrine deposits or glacial outwash
Slope range: 0 to 12 percent
Taxonomic classification: Coarse-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Gardencity very fine sandy loam, 2 to 6 percent slopes, 1,000 feet east and 2,100 feet north of the southwest corner of sec. 29, T. 120 N., R. 30 W.

Ap—0 to 9 inches; very dark brown (10YR 2/2) very fine sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

A—9 to 13 inches; very dark grayish brown (10YR 3/2) very fine sandy loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; very many very dark brown (10YR 2/2) organic coatings on faces of peds; neutral; clear smooth boundary.

AB—13 to 18 inches; dark brown (10YR 3/3) very fine sandy loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; very many very dark grayish brown (10YR 3/2) organic coatings on faces of peds; neutral; clear smooth boundary.

Bw1—18 to 28 inches; dark brown (10YR 4/3) loamy fine sand with strata of very fine sandy loam; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; neutral; clear smooth boundary.

Bw2—28 to 34 inches; dark brown (10YR 4/3) very fine sandy loam with strata of loamy fine sand; weak medium subangular blocky structure parting to weak fine subangular blocky; very friable; neutral; abrupt smooth boundary.

C1—34 to 42 inches; brown (10YR 5/3) very fine sandy loam with strata of loamy very fine sand; weak medium subangular blocky structure parting to weak fine subangular blocky; very friable; strongly effervescent; slightly alkaline; clear smooth boundary.

C2—42 to 60 inches; brown (10YR 5/3) loamy very fine sand; weak medium subangular blocky structure parting to weak fine subangular blocky; very friable; few fine distinct grayish brown (2.5Y 5/2) iron depletions; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to more than 60 inches
Thickness of the mollic epipedon: 10 to 24 inches
Other features: In some pedons the lower part of the Bw horizon and an underlying Bk horizon are dominantly silt loam or very fine sandy loam.

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—very fine sandy loam or fine sandy loam

Bw horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 to 6
Texture—dominantly stratified fine sand, very fine sand, loamy fine sand, loamy very fine sand, fine sandy loam, very fine sandy loam, and silt loam; thin strata of sand or loamy sand in some pedons

C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—3 to 6
Texture—commonly stratified with silt loam, very fine sandy loam, or loamy very fine sand; fine sandy loam or fine sandy loam in some pedons

1177C—Gardencity-Bold complex, 6 to 12 percent slopes, eroded

Composition

Gardencity and similar soils: About 70 percent
Bold and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Gardencity—outwash plains and lake plains; Bold—outwash plains and terraces
Position on the landform: Gardencity—summits and backslopes; Bold—shoulders and summits
Slope range: 6 to 12 percent

Component Description

Gardencity

Surface layer texture: Fine sandy loam
Depth to bedrock: Greater than 80 inches
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits or glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.7 inches (moderate)
Content of organic matter in the surface layer: About 3 percent (moderate)

Bold

Surface layer texture: Silt loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 13.2 inches (high)
Content of organic matter in the surface layer: About 1.25 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Madelia and similar soils
- Darfur and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1185—Gardencity fine sandy loam, moderately wet, 0 to 2 percent slopes

Composition

Gardencity and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Flats and rises on lake plains and outwash plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Fine sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Glaciolacustrine deposits or glacial outwash
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.0 inches (high)
Content of organic matter in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Dassel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1801B—Gardencity very fine sandy loam, 2 to 6 percent slopes

Composition

Gardencity and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Lake plains and outwash plains
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Surface layer texture: Very fine sandy loam
Depth to bedrock: Greater than 80 inches
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits or glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.8 inches (moderate)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Truman and similar soils
- Sparta and similar soils
- Madelia and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Glencoe Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow
Landform: Moraines
Parent material: Till
Slope range: 0 to 1 percent
Taxonomic classification: Fine-loamy, mixed, mesic Cumulic Endoaquolls

Typical Pedon

Glencoe clay loam, depressional, 0 to 1 percent slopes, 2,300 feet east and 500 feet south of the northwest corner of sec. 30, T. 115 N., R. 30 W., in McLeod County:

Ap—0 to 10 inches; black (N 2/0) clay loam, black (10YR 2/1) dry; weak medium subangular blocky structure; friable; 2 percent gravel; abrupt smooth boundary.

A1—10 to 24 inches; black (N 2/0) clay loam, black (10YR 2/1) dry; weak medium subangular blocky structure; friable; slightly alkaline; 2 percent gravel; clear smooth boundary.

A2—24 to 34 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; friable; 1 percent gravel; neutral; gradual wavy boundary.

Bg1—34 to 48 inches; olive gray (5Y 4/2) clay loam; weak fine subangular blocky structure; friable; few fine distinct dark gray (10YR 4/1) iron depletions and few fine distinct yellowish brown (10YR 5/6) iron concentrations; 1 percent gravel; neutral; gradual wavy boundary.

Bg2—48 to 80 inches; light olive gray (5Y 6/2) clay loam; weak medium prismatic structure; friable; common medium distinct yellowish brown (10YR 5/6) iron concentrations; 2 percent gravel; neutral.

Range in Characteristics

Depth to carbonates: 30 to more than 60 inches
Thickness of the mollic epipedon: 24 to 60 inches

Ap horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam, clay loam, or loam
Content of rock fragments—0 to 2 percent gravel

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam or clay loam
Content of rock fragments—0 to 2 percent gravel

Bg horizon:
Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam, clay loam, or silty clay loam
Content of rock fragments—1 to 2 percent gravel; 0 to 2 percent cobbles and stones

Bkg horizon:
Hue—5Y or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam or clay loam
Content of rock fragments—2 to 4 percent gravel; 2 to 4 percent cobbles and stones

114—Glencoe clay loam, depressional, 0 to 1 percent slopes

Composition

Glencoe and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Depressions on moraines
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 11.2 inches (high)
Content of organic matter in the surface layer: About 7.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Canisteo and similar soils
- Klossner and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Granby Series

Depth class: Very deep
Drainage class: Poorly drained and very poorly drained
Permeability: Rapid
Landform: Outwash plains and beach ridges
Parent material: Glacial outwash
Slope range: 0 to 1 percent

Taxonomic classification: Sandy, mixed, mesic Typic Endoaquolls

Typical Pedon

Granby fine sandy loam, 0 to 1 percent slopes, 2,500 feet south and 2,500 feet west of the northeast corner of sec. 24, T. 121 N., R. 31 W.

Ap—0 to 10 inches; black (N 2/0) fine sandy loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

A1—10 to 13 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (N 4/0) dry; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

A2—13 to 20 inches; very dark gray (5Y 3/1) loamy fine sand; weak fine subangular blocky structure; very friable; few fine faint yellowish brown (10YR 5/6) and dark gray (10YR 4/1) iron depletions; neutral; clear smooth boundary.

Bg1—20 to 23 inches; light olive gray (5Y 6/2) fine sand; weak fine subangular blocky structure; loose; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; neutral; abrupt smooth boundary.

Bg2—23 to 26 inches; light olive gray (5Y 6/2) fine sandy loam; moderate fine subangular blocky structure; very friable; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; neutral; abrupt smooth boundary.

Cg—26 to 60 inches; light brownish gray (2.5Y 6/2) fine sand; weak fine subangular blocky structure; loose; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; neutral.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches
Depth to sand or loamy fine sand: Less than 15 inches
Thickness of the mollic epipedon: 10 to 15 inches

Ap horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—fine sandy loam or loamy fine sand

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 to 2
Texture—fine sandy loam, loamy fine sand, or fine sand

Bg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—1 or 2
Texture—fine sand, loamy fine sand, or sand; thin layers of fine sandy loam, loamy very fine sand, or very fine sandy loam in some pedons

Cg horizon:
Hue—2.5Y, 5Y, or 5GY
Value—5 or 6
Chroma—1 to 3
Texture—fine sand or loamy fine sand

178—Granby fine sandy loam, 0 to 1 percent slopes

Composition

Granby and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on outwash plains
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Fine sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 5.7 inches (low)
Content of organic matter in the surface layer: About 5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the “Soil Properties” section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Dassel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1099—Granby loamy fine sand, very wet, 0 to 1 percent slopes

Composition

Granby and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Beach ridges
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Loamy fine sand
Depth to bedrock: Greater than 60 inches
Dominant parent material: Glacial outwash
Flooding: None
Seasonal high water table: 1 foot above to 1 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 4.9 inches (low)
Content of organic matter in the surface layer: About 7 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Klossner and similar soils
- Fieldon and similar soils

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Grovecity Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately rapid
Landform: Moraines
Parent material: Till
Slope range: 1 to 3 percent
Taxonomic classification: Coarse-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Grovecity loam, 1 to 3 percent slopes, 260 feet north and 40 feet west of the southeast corner of sec. 11, T. 120 N., R. 32 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; 1 percent gravel; 1 percent cobbles and stones; slightly acid; abrupt smooth boundary.

A—10 to 15 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak fine and medium subangular blocky structure; friable; 1 percent gravel; 1 percent cobbles and stones; neutral; clear wavy boundary.

Bw1—15 to 20 inches; olive brown (2.5Y 4/4) sandy loam; weak medium subangular blocky structure; friable; few fine prominent dark yellowish brown (10YR 4/6) iron concentrations; common dark grayish brown (2.5Y 4/2) organic coatings on faces of peds; 4 percent gravel; 3 percent cobbles and stones; neutral; clear wavy boundary.

Bw2—20 to 30 inches; olive brown (2.5Y 4/4) sandy loam; weak medium subangular blocky structure; friable; few fine distinct grayish brown (2.5Y 5/2) iron depletions and few fine distinct dark yellowish brown (10YR 4/6) iron concentrations; 4 percent gravel; 4 percent cobbles and stones; slightly alkaline; clear wavy boundary.

Bk—30 to 42 inches; light olive brown (2.5Y 5/4) fine sandy loam; massive; friable; common medium distinct light brownish gray (2.5Y 6/2) iron depletions; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 6 percent gravel; 4 percent cobbles and stones; strongly effervescent; slightly alkaline; gradual wavy boundary.

C—42 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam; massive; friable; common medium distinct light brownish gray (2.5Y 5/2) iron depletions; few fine masses and threads of calcium carbonate; 6 percent gravel; 4 percent cobbles and stones; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 18 to 36 inches
Thickness of the mollic epipedon: 8 to 18 inches

A horizon:
Hue—10YR

Value—2 or 3
Chroma—1 or 2
Texture—loam
Content of rock fragments—2 to 3 percent gravel; 0 to 2 percent cobbles and stones

Bw horizon:
Hue—2.5Y or 10YR
Value—4 or 5
Chroma—2 to 4
Texture—fine sandy loam, sandy loam, or loam
Content of rock fragments—4 to 8 percent gravel; 3 to 5 percent cobbles and stones

Bk horizon:
Hue—2. 5Y or 5Y
Value—4 to 6
Chroma—2 to 6
Texture—fine sandy loam, sandy loam, or loam
Content of rock fragments—4 to 6 percent gravel; 3 to 5 percent cobbles and stones

613—Grovecity loam, 1 to 3 percent slopes

Composition

Grovecity and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 1 to 3 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.0 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Uniongrove and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Hamel Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Moraines
Parent material: Colluvium over till
Slope range: 0 to 3 percent
Taxonomic classification: Fine-loamy, mixed, mesic Typic Argiaquolls

Typical Pedon

Hamel loam, in an area of Hamel-Glencoe, depressional, complex, 0 to 3 percent slopes, 1,700 feet north and 2,100 feet east of the southwest corner of sec. 22, T. 118 N., R. 29 W.

A1—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

A2—10 to 19 inches; black (N 2/0) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to moderate very fine subangular blocky; friable; neutral; clear smooth boundary.

A3—19 to 28 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak fine angular blocky structure parting to moderate very fine angular blocky; friable; few black (N 2/0) clay films on faces of peds and in pores; about 1 percent gravel; neutral; clear smooth boundary.

AB—28 to 40 inches; very dark gray (10YR 3/1) clay loam, gray (10YR 5/1) dry; moderate medium angular blocky structure parting to moderate very fine angular blocky; firm; many black (N 2/0) clay films on faces of peds and in pores; about 1 percent gravel; neutral; clear smooth boundary.

Btg1—40 to 47 inches; very dark gray (10YR 3/1) clay loam, gray (10YR 5/1) dry; moderate medium prismatic structure parting to moderate coarse angular blocky; firm; many black (N 2/0) clay films on faces of peds and in pores; about 2 percent gravel; neutral; clear smooth boundary.

Btg2—47 to 56 inches; olive gray (5Y 5/2) clay loam; weak medium prismatic structure parting to moderate coarse angular blocky; firm; few black (N 2/0) clay films in channels; about 2 percent gravel; neutral; clear smooth boundary.

Bkg1—56 to 65 inches; light olive gray (5Y 6/2) loam; weak coarse subangular blocky structure parting to weak medium platy; friable; common fine prominent light olive brown (2.5Y 5/6) iron concentrations; about 4 percent gravel; about 1 percent cobbles; slightly effervescent; slightly alkaline; clear smooth boundary.

Bkg2—65 to 80 inches; light olive gray (5Y 6/2) loam; weak coarse subangular blocky structure parting to weak medium platy; friable; many medium prominent light olive brown (2.5Y 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; about 4 percent gravel; about 1 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 30 to more than 60 inches
Thickness of the mollic epipedon: 24 to 44 inches

Ap horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loam or clay loam
Content of rock fragments—0 to 2 percent gravel

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam or loam
Content of rock fragments—0 to 2 percent gravel

Btg horizon:
Hue—5Y or 2.5Y
Value—2 to 4
Chroma—1 or 2
Texture—clay loam, silty clay loam, or loam
Content of rock fragments—1 to 4 percent gravel; 1 to 4 percent cobbles and stones

Bkg horizon:
Hue—5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam
Content of rock fragments—2 to 4 percent gravel; 2 to 4 percent cobbles and stones

740—Hamel-Glencoe, depressional, complex, 0 to 3 percent slopes

Composition

Hamel and similar soils: About 70 percent
Glencoe and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Hamel—drainageways; Glencoe—depressions
Slope range: Hamel—0 to 3 percent; Glencoe—0 to 1 percent

Component Description

Hamel

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Colluvium over till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.7 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

Glencoe

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 11.6 inches (high)
Content of organic matter in the surface layer: About 7.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Le Sueur and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Harps Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy, mesic Typic Calciaquolls

Typical Pedon

Harps clay loam, 0 to 2 percent slopes, 2,200 feet north and 2,000 feet west of the southeast corner of sec. 28, T. 117 N., R. 31 W.

Apk—0 to 9 inches; black (N 2/0) clay loam, dark gray (N 4/0) dry; moderate very fine subangular blocky structure; friable; 1 percent gravel; violently effervescent; slightly alkaline; clear smooth boundary.

Ak—9 to 19 inches; very dark gray (10YR 3/1) clay loam, gray (N 5/0) dry; weak medium subangular blocky structure; friable; 2 percent gravel; 2 percent cobbles and stones; violently effervescent; slightly alkaline; clear smooth boundary.

Bkg1—19 to 25 inches; dark gray (5Y 4/1) clay loam; weak medium subangular blocky structure parting to weak coarse subangular blocky; friable; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; 2 percent gravel; 2 percent cobbles and stones; violently effervescent; slightly alkaline; clear smooth boundary.

Bkg2—25 to 60 inches; light olive gray (5Y 6/2) loam; weak coarse subangular blocky structure; friable; many fine prominent dark yellowish brown (10YR 4/6) and common light olive brown (2.5Y 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface
Thickness of the mollic epipedon: 12 to 21 inches

Apk horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—clay loam
Content of rock fragments—1 to 2 percent gravel; 0 to 1 percent cobbles and stones

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loam or clay loam
Content of rock fragments—1 to 3 percent gravel; 0 to 2 percent cobbles and stones

Bkg1 horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 or 2
Texture—clay loam or loam
Content of rock fragments—1 to 3 percent gravel; 1 to 2 percent cobbles and stones

Bkg2 horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—2
Texture—loam
Content of rock fragments—2 to 4 percent gravel; 1 to 4 percent cobbles and stones

112—Harps clay loam, 0 to 2 percent slopes

Composition

Harps and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Rims of depressions on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None

Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.7 inches (high)
Content of organic matter in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Okoboji and similar soils
- Glencoe and similar soils
- Seaforth and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

899—Harps-Okoboji, depressional, complex, 0 to 2 percent slopes

Composition

Harps and similar soils: About 60 percent
Okoboji and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Harps—moraines; Okoboji—lake plains and moraines
Position on the landform: Harps—rims of depressions; Okoboji—depressions
Slope range: Harps—0 to 2 percent; Okoboji—0 to 1 percent

Component Description

Harps

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter in the surface layer: About 4 percent (high)

Okoboji

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Lacustrine deposits over till
Flooding: None
Depth to the water table: 1 foot above to 1 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 11.9 inches (high)
Content of organic matter in the surface layer: About 8.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Seaforth and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Havelock Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy, mixed (calcareous), mesic Cumulic Endoaquolls

Typical Pedon

Havelock loam, 0 to 2 percent slopes, frequently flooded, 100 feet south and 1,500 feet east of the northwest corner of sec. 9, T. 116 N., R. 30 W., in McLeod County:

A1—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; slightly effervescent; slightly alkaline; gradual wavy boundary.

A2—9 to 15 inches; black (10YR 2/1) loam with few sand seams, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; friable; common fine distinct dark yellowish brown (10YR 4/4) iron concentrations; slightly effervescent; slightly alkaline; gradual wavy boundary.

Bg—15 to 38 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; common medium distinct dark yellowish brown (10YR 4/4) iron concentrations; strongly effervescent with disseminated calcium carbonate; slightly alkaline; gradual irregular boundary.

Cg—38 to 60 inches; dark gray (10YR 4/1) loam; massive; friable; few fine distinct dark brown (10YR 3/3) iron depletions; very few very dark gray (10YR 3/1) organic coatings; strongly effervescent with disseminated calcium carbonate; slightly alkaline.

Range in Characteristics

Carbonates: At the surface
Thickness of the mollic epipedon: 24 to 40 inches

A1 horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—loam

A2 horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam, silt loam, silty clay loam, or clay loam

B horizon:
Hue—10YR or 2.5Y
Value—2 to 4
Chroma—1 or 2
Texture—loam, clay loam, or silt loam

Cg horizon:
Hue—10YR
Value—4 or 5
Chroma—1 or 2
Texture—loam, clay loam, sandy loam, or silty clay loam

1385—Havelock loam, 0 to 2 percent slopes, frequently flooded

Composition

Havelock and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats and swales on flood plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Alluvium
Flooding: Frequent
Seasonal high water table: At the surface to 1 foot below the surface
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.3 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Calco and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Hawick Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Very rapid
Landform: Outwash plains, terraces, and moraines
Parent material: Glacial outwash
Taxonomic classification: Sandy, mixed, mesic Entic Hapludolls

Typical Pedon

Hawick sandy loam, in an area of Estherville-Hawick complex, 2 to 6 percent slopes, 160 feet north and 100 feet east of the southwest corner of sec. 4, T. 119 N., R. 29 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; very friable; 12 percent gravel; neutral; clear smooth boundary.

Bw—7 to 11 inches; dark brown (10YR 3/3) gravelly loamy coarse sand, dark brown (10YR 4/3) dry; weak fine subangular blocky structure; very friable; 20 percent gravel; slightly alkaline; abrupt smooth boundary.

2Bk—11 to 60 inches; light yellowish brown (2.5Y 6/4) gravelly coarse sand; single grain; loose; 30 percent gravel; common soft white (10YR 8/2) accumulations of calcium carbonate on underside of gravel and very coarse sand fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 30 inches
Thickness of the loamy mantle: 0 to 10 inches
Thickness of the mollic epipedon: 7 to 16 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—sandy loam, gravelly sand, gravelly loamy sand, or gravelly sandy loam
Content of rock fragments—5 to 25 percent gravel

Bw horizon:
Hue—10YR or 7.5YR
Value—3 or 4
Chroma—3 or 4
Texture—gravelly loamy coarse sand, coarse sand, loamy coarse sand, or loamy sand
Content of rock fragments—5 to 25 percent gravel

2Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—2 to 6
Texture—coarse sand, gravelly coarse sand, or gravelly sand
Content of rock fragments—10 to 35 percent gravel

611D—Hawick gravelly sandy loam, 12 to 25 percent slopes

Composition

Hawick and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Backslopes and shoulders
Slope range: 12 to 25 percent

Component Description

Surface layer texture: Gravelly sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 2.8 inches (very low)
Content of organic matter in the surface layer: About 2 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Minneopa and similar soils
- Biscay and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

875C—Hawick-Estherville complex, 6 to 12 percent slopes

Composition

Hawick and similar soils: About 60 percent
Estherville and similar soils: About 25 percent
Inclusions: About 15 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Hawick—summits and backslopes; Estherville—shoulders and summits
Slope range: 6 to 12 percent

Component Description

Hawick

Surface layer texture: Gravelly sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 2.8 inches (very low)
Content of organic matter in the surface layer: About 2 percent (moderate)

Estherville

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.4 inches (low)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Minneopa and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Houghton Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow to moderately rapid
Landform: Moraines, outwash plains, and lake plains
Parent material: Organic materials
Slope range: 0 to 1 percent
Taxonomic classification: Euic, mesic Typic Medisaprists

Typical Pedon

Houghton muck, depressional, 0 to 1 percent slopes, 1,100 feet north and 1,050 feet west of the southeast corner of sec. 8, T. 119 N., R. 29 W.

Oa1—0 to 7 inches; muck (sapric material), black (N 2/0) broken face and unrubbed; weak very fine granular structure; very friable; many fine roots; neutral; abrupt smooth boundary.

Oa2—7 to 56 inches; muck (sapric material), black (10YR 2/1) and dark brown (7.5YR 3/3) broken face; about 50 percent fiber, 5 percent rubbed; weak thin platy structure; very friable; many fine roots; neutral; gradual smooth boundary.

Oa3—56 to 60 inches; muck (sapric material), black (10YR 2/1) and dark brown (7.5YR 3/4) broken face; about 60 percent fiber, 15 percent rubbed; weak thin platy structure; very friable; many fine roots; neutral.

Range in Characteristics

Depth to mineral soil: Greater than 51 inches

O horizon:
Hue—5YR to 10YR or neutral
Value—2 or 3
Chroma—0 to 3
Texture—muck

523—Houghton muck, depressional, 0 to 1 percent slopes

Composition

Houghton and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Depressions on lake plains, outwash plains, and moraines
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials
Flooding: None

Seasonal high water table: 1 foot above to 1 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 24.0 inches (high)
Content of organic matter in the surface layer: About 84.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Klossner and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Kanaranzi Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate in the loamy mantle and very rapid in the underlying sand and gravel
Landform: Outwash plains and terraces
Parent material: Glacial outwash
Slope range: 0 to 3 percent
Taxonomic classification: Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls

Typical Pedon

Kanaranzi loam, 0 to 3 percent slopes (fig. 12), 100 feet west and 2,000 feet south of the northeast corner of sec. 25, T. 119 N., R. 31 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common roots; neutral; clear smooth boundary.

Bw1—9 to 14 inches; dark brown (7.5YR 4/4) loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; common roots; 3 percent gravel; neutral; clear wavy boundary.

Bw2—14 to 18 inches; dark yellowish brown (10YR 4/4) coarse sandy loam; weak fine subangular blocky structure; very friable; common roots; very many brown (10YR 4/3) organic coatings on faces of peds; 3 percent gravel; neutral; clear wavy boundary.

2Bw3—18 to 26 inches; dark brown (10YR 4/3) loamy coarse sand; single grain; loose; 10 percent gravel; neutral; clear wavy boundary.

2Bk—26 to 60 inches; brown (10YR 5/3) gravelly coarse sand; single grain; loose; 17 percent gravel; few soft white (10YR 8/2) accumulations of calcium carbonate on underside of gravel and very coarse sand fragments; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 28 inches
Thickness of the loamy mantle: 14 to 20 inches
Thickness of the mollic epipedon: 8 to 14 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam
Content of rock fragments—0 to 5 percent gravel

Bw horizon:
Hue—10YR or 7.5YR
Value—3 or 4
Chroma—3 or 4
Texture—loam in the upper part; sandy loam, coarse sandy loam, or gravelly coarse sandy loam in the lower part
Content of rock fragments—2 to 5 percent gravel in the upper part; as much as 35 percent gravel in the lower part

2Bk horizon:
Hue—10YR
Value—4 to 6
Chroma—2 to 4
Texture—coarse sand or gravelly coarse sand
Content of rock fragments—10 to 50 percent gravel

415—Kanaranzi loam, 0 to 3 percent slopes

Composition

Kanaranzi and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces
Slope range: 0 to 3 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.5 inches (low)
Content of organic matter in the surface layer: About 3.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Cylinder and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Kandiyohi Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Slow
Landform: Moraines
Parent material: Glaciolacustrine deposits over till
Slope range: 0 to 5 percent
Taxonomic classification: Fine, montmorillonitic, mesic Aquertic Hapludolls

Typical Pedon

Kandiyohi clay, 2 to 5 percent slopes (fig. 13), 1,950 feet east and 875 feet north of the southwest corner of sec. 5, T. 118 N., R. 32 W.

Ap—0 to 10 inches; black (10YR 2/1) clay, dark gray (10YR 4/1) dry; strong fine angular blocky structure; firm; about 1 percent gravel; slightly acid; abrupt smooth boundary.

Bw1—10 to 17 inches; olive brown (2.5Y 4/3) clay; strong fine prismatic structure parting to strong very fine angular blocky; firm; very dark brown (10YR 2/2) organic coatings on faces of peds; about 1 percent gravel; slightly acid; gradual wavy boundary.

Bw2—17 to 23 inches; olive brown (2.5Y 4/3) clay; strong medium prismatic structure parting to strong very fine angular blocky; firm; few fine distinct light olive brown (2.5Y 5/6) iron concentrations and few fine prominent light olive gray (5Y 6/2) iron depletions; very many very dark grayish brown (2.5Y 3/2) organic coatings on pressure faces; about 1 percent gravel; neutral; gradual wavy boundary.

Bkg1—23 to 29 inches; grayish brown (2.5Y 5/2) clay; moderate medium prismatic structure parting to moderate fine angular blocky; firm; common fine distinct light olive brown (2.5Y 5/4) iron concentrations and common fine distinct light olive gray (5Y 6/2) iron depletions; few fine irregular soft white (10YR 8/1) masses and threads of calcium carbonate distributed uniformly throughout the horizon; common dark grayish brown (2.5Y 4/2) organic coatings on pressure faces; about 2 percent gravel; strongly effervescent; slightly alkaline; gradual wavy boundary.

2Bkg2—29 to 60 inches; grayish brown (2.5Y 5/2) clay loam; moderate coarse prismatic structure parting to moderate fine angular blocky; firm; many medium prominent yellowish brown (10YR 5/6) iron concentrations and common fine distinct light olive gray (5Y 6/2) iron depletions; common fine irregular soft white (10YR 8/1) masses and threads of calcium carbonate distributed uniformly throughout the horizon; about 4 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 36 inches
Thickness of the mollic epipedon: 10 to 24 inches

Ap horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2
Texture—clay, silty clay, or silty clay loam
Content of rock fragments—0 to 1 percent gravel; 0 to 1 percent cobbles and stones

Bw horizon:
Hue—2.5Y

Value—4 or 5
Chroma—2 to 4
Texture—clay, silty clay, or silty clay loam (average clay content is 35 to 60 percent)
Content of rock fragments—0 to 1 percent gravel; 0 to 1 percent cobbles and stones

Bkg or 2Bkg horizon:
Hue—2.5Y or 5Y
Value—4 to 6
Chroma—2 to 4
Texture—commonly clay loam or clay; silty clay loam in some pedons
Content of rock fragments—2 to 4 percent gravel; 1 to 2 percent cobbles and stones

1162A—Kandiyohi clay, 0 to 2 percent slopes

Composition

Kandiyohi and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats and rises on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Clay
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Depth to the water table: 1.5 to 2.5 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)
Content of organic matter in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cosmos and similar soils
- Lura and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1162B—Kandiyohi clay, 2 to 5 percent slopes

Composition

Kandiyohi and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Rises on moraines
Slope range: 2 to 5 percent

Component Description

Surface layer texture: Clay
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Glaciolacustrine deposits over till
Flooding: None
Depth to the water table: 1.5 to 2.5 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.0 inches (high)
Content of organic matter in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cosmos and similar soils
- Lura and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Kingston Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate

Landform: Lake plains
Parent material: Lacustrine deposits
Slope range: 1 to 3 percent
Taxonomic classification: Fine-silty, mixed, mesic Aquic Hapludolls

Typical Pedon

Kingston silty clay loam, 1 to 3 percent slopes, 1,620 feet north and 100 feet west of the southeast corner of sec. 26, T. 120 N., R. 30 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

A1—8 to 13 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine and very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

A2—13 to 16 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine and very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

Bw1—16 to 20 inches; dark grayish brown (10YR 4/2) silty clay loam; weak fine subangular blocky structure; friable; many very dark grayish brown (2.5Y 3/2) organic coatings on faces of peds; slightly acid; clear smooth boundary.

Bw2—20 to 25 inches; dark grayish brown (2.5Y 4/2) silt loam; weak fine subangular blocky structure; friable; many fine distinct light olive brown (2.5Y 5/4) iron concentrations; slightly acid; abrupt smooth boundary.

Bk—25 to 60 inches; light olive brown (2.5Y 5/4) silt loam; weak thin to thick platy structure; very friable; common fine distinct olive gray (5Y 5/2) and distinct olive (5Y 5/3) iron depletions; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 32 inches
Thickness of the mollic epipedon: 12 to 24 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—silty clay loam

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—silty clay loam or silt loam

Bk horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 to 4
Texture—silt loam

197—Kingston silty clay loam, 1 to 3 percent slopes

Composition

Kingston and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Slight rises on lake plains
Slope range: 1 to 3 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.3 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Madelia and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Klossner Series

Depth class: Very deep
Drainage class: Very poorly drained

Permeability: Moderate in the organic material; moderately slow to very rapid in the underlying mineral material
Landform: Moraines, lake plains, and flood plains
Parent material: Organic materials over glaciolacustrine deposits or till
Slope range: 0 to 1 percent
Taxonomic classification: Loamy, mixed, euic Terric Medisaprists

Typical Pedon

Klossner muck, depressional, 0 to 1 percent slopes, 600 feet east and 100 feet south of the northwest corner of sec. 27, T. 120 N., R. 31 W.

Oa1—0 to 7 inches; muck (sapric material), black (N 2/0) broken face and rubbed; about 20 percent fiber, trace rubbed; weak fine subangular blocky structure; friable; common fine roots; neutral; clear smooth boundary.
Oa2—7 to 28 inches; muck (sapric material), very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed; about 60 percent fiber, 10 percent rubbed; weak medium platy structure; friable; few fine roots; neutral; abrupt smooth boundary.
2A—28 to 34 inches; black (N 2/0) silt loam; massive; sticky; slightly effervescent; slightly alkaline; clear smooth boundary.
2Cg1—34 to 45 inches; olive gray (5Y 4/2) silt loam; massive; friable; common fine prominent yellowish brown (10YR 5/8) iron concentrations; strongly effervescent; slightly alkaline; clear smooth boundary.
2Cg2—45 to 60 inches; dark gray (5Y 4/1) loam; massive; friable; common fine prominent (10YR 5/8) iron concentrations; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to mineral soil: 16 to 50 inches

O horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—muck

2A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—sandy loam, fine sandy loam, loam, silt loam, or silty clay loam

2Cg horizon:
Hue—5Y or 5GY
Value—4 to 6
Chroma—1 or 2
Texture—loam, clay loam, silt loam, silty clay loam, or fine sandy loam
Content of rock fragments—0 to 10 percent gravel

539—Klossner muck, depressional, 0 to 1 percent slopes

Composition

Klossner and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Depressions on lake plains and moraines
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials over glaciolacustrine deposits or till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 18.3 inches (high)
Content of organic matter in the surface layer: About 42.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1080—Klossner, Okoboji, and Glencoe soils, ponded, 0 to 1 percent slopes

Composition

Klossner: Variable
Okoboji: Variable
Glencoe: Variable
Inclusions: About 10 percent

Setting

Landform: Depressions on moraines
Slope range: 0 to 1 percent

Component Description

Klossner

Surface layer texture: Muck
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials over glaciolacustrine deposits or till
Flooding: None
Seasonal high water table: At the surface to 3 feet above the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 16.3 inches (high)
Content of organic matter in the surface layer: About 42.5 percent (very high)

Okoboji

Surface layer texture: Mucky silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Lacustrine deposits over till
Flooding: None
Seasonal high water table: 3 feet above to 1 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 11.9 inches (high)
Content of organic matter in the surface layer: About 14 percent (very high)

Glencoe

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: At the surface to 3 feet above the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 11.5 inches (high)
Content of organic matter in the surface layer: About 7.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Canisteo and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1199—Klossner and Lundlake soils, ponded

Composition

Klossner and similar soils: About 50 percent
Lundlake and similar soils: About 45 percent
Inclusions: About 5 percent

Setting

Landform: Depressions on moraines
Slope range: 0 to 1 percent

Component Description

Klossner

Surface layer texture: Muck
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials over till
Flooding: None
Seasonal high water table: At the surface to 3 feet above the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 19.2 inches (high)
Content of organic matter in the surface layer: About 42.5 percent (very high)

Lundlake

Surface layer texture: Mucky loam

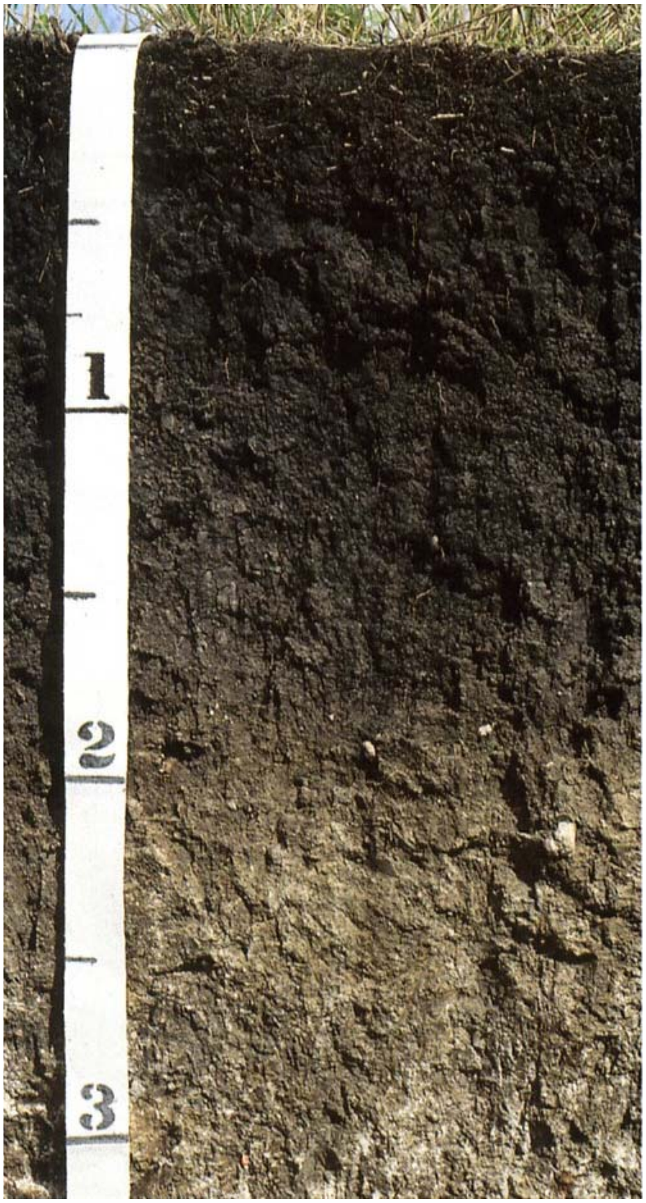

Figure 11.—A profile of Cosmos silty clay in a cultivated field. Light-colored calcium carbonates are below a depth of about 24 inches. Depth is marked in feet.

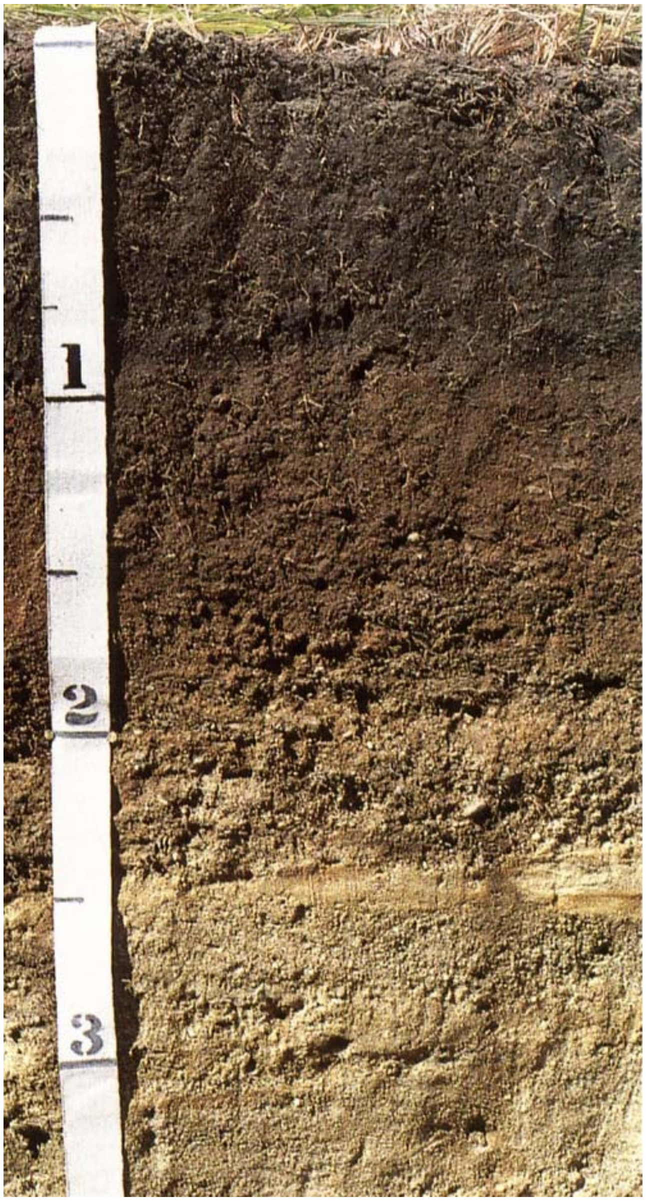

Figure 12.—A profile of Kanaranzi loam in a cultivated field. The loamy mantle is about 18 inches thick over outwash sands and gravel. Depth is marked in feet.

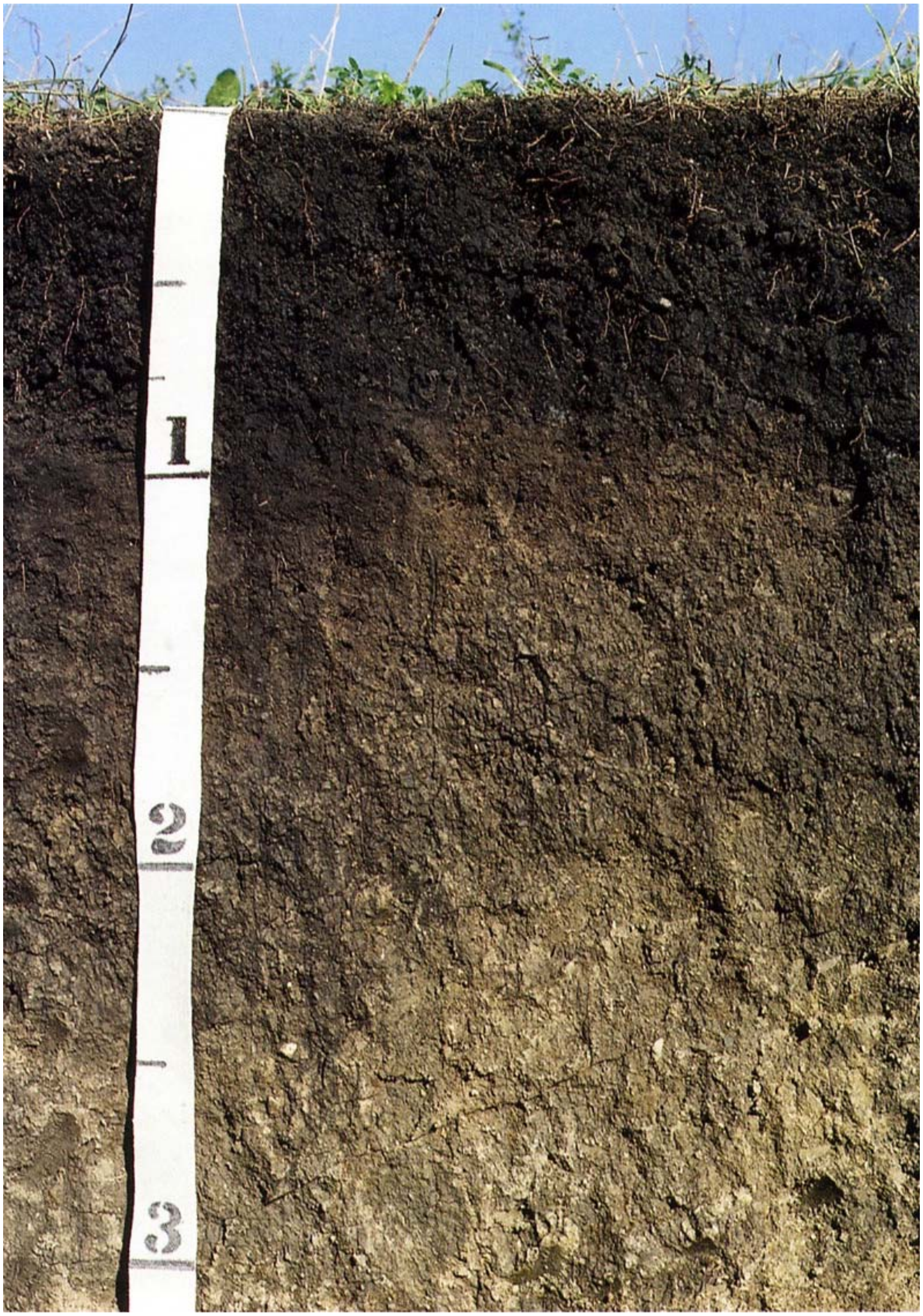

Figure 13.—A profile of Kandiyohi clay in a cultivated field. The horizon boundaries are wavy because of shrinking and swelling. Depth is marked in feet.

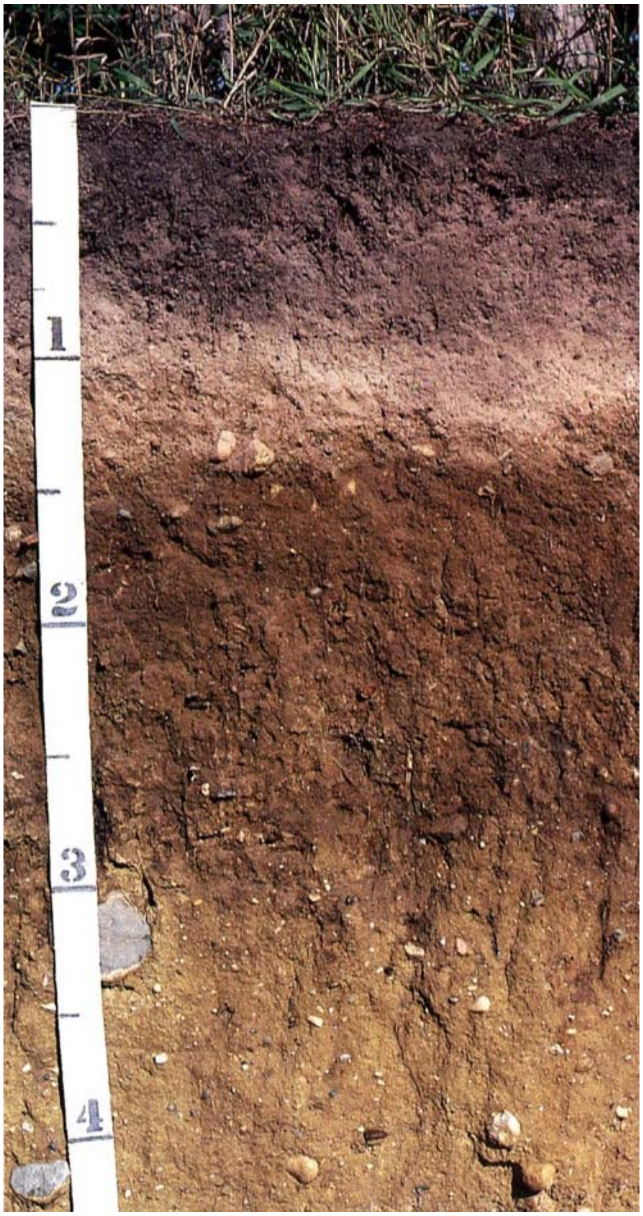

Figure 14.—A profile of Koronis loam in an area that has not been cultivated. The light-colored E horizon, at a depth of 9 to 13 inches, is a result of the washing of soil materials from this horizon to lower horizons. In cultivated areas the E horizon is commonly mixed with the A horizon. Depth is marked in feet.

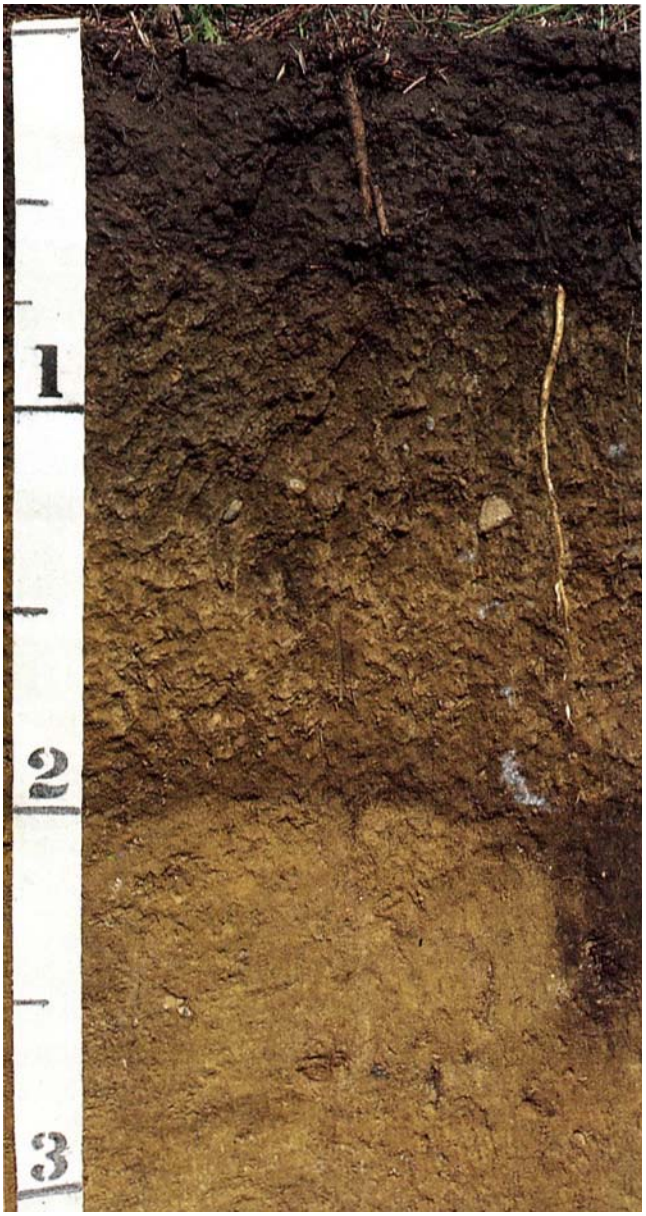

Figure 15.—A profile of Lester loam in a cultivated field. The Bt horizon, at a depth of 7 to 24 inches, has an accumulation of clay. Depth is marked in feet.

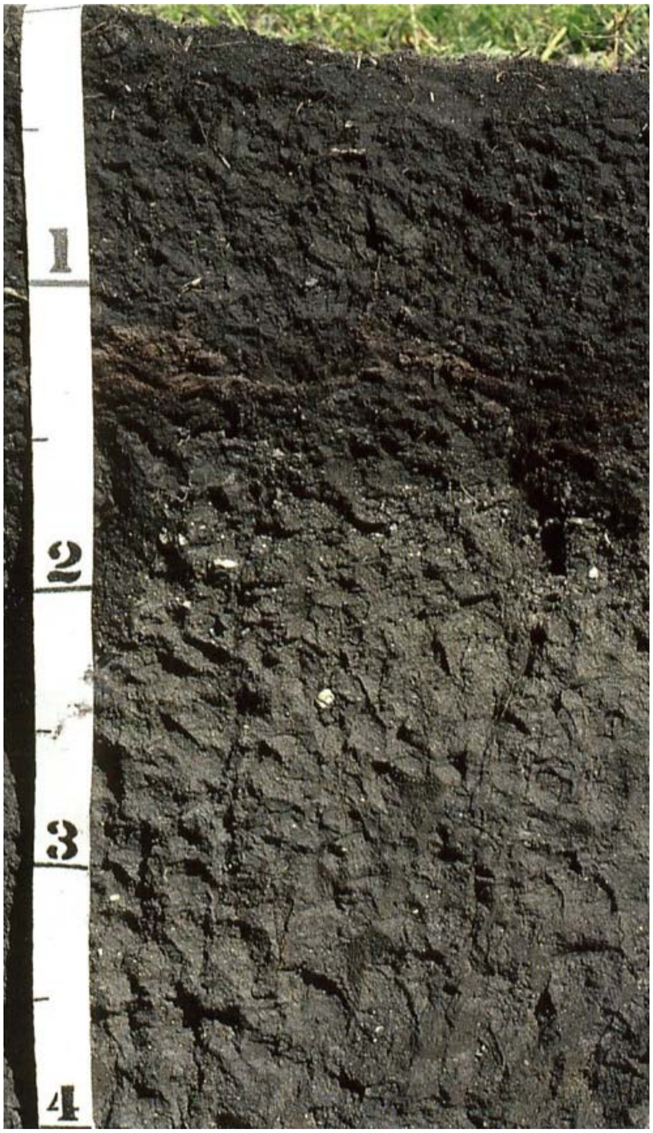

Figure 16.—A profile of Muskego muck in a cultivated field. The black sapric material extends to a depth of about 18 inches over gray coprogenous earth. Note the snail-shell fragments in the coprogenous earth. Depth is marked in feet.

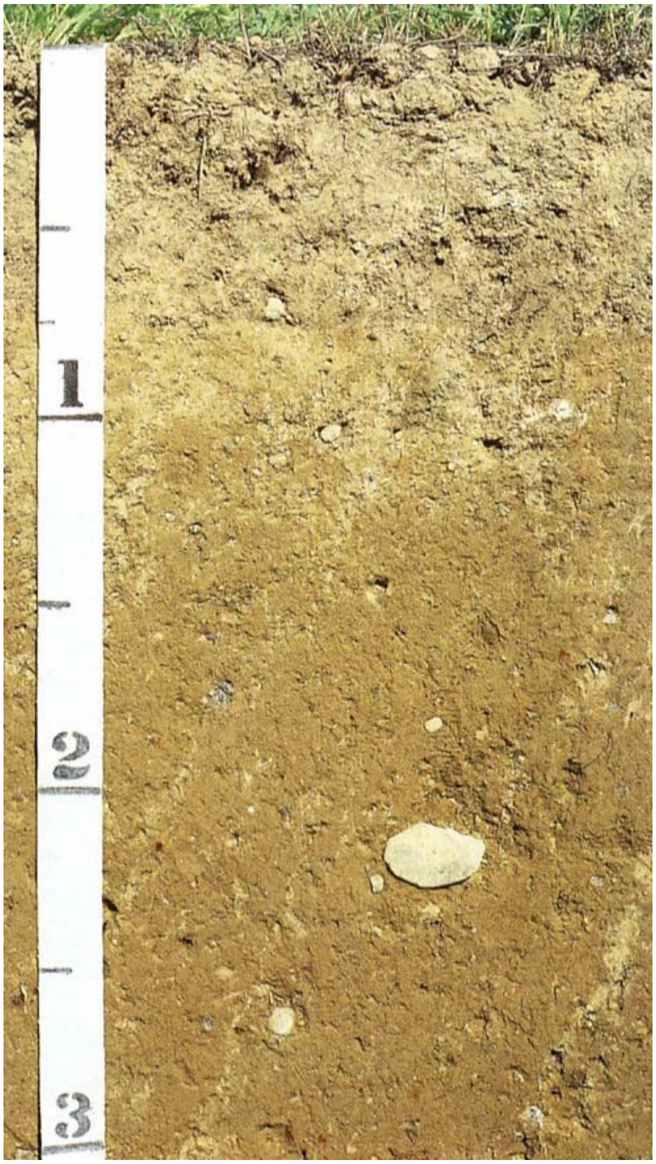

Figure 17.—A profile of Storden loam in a cultivated field. Storden soils have calcium carbonates at the surface. Depth is marked in feet.

Depth to bedrock: Greater than 80 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: At the surface to 3 feet above the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 11.4 inches (high)
Content of organic matter in the surface layer: About 15 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Houghton and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Koronis Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Ground moraines
Parent material: Calcareous, loamy glacial till
Slope range: 2 to 40 percent
Taxonomic classification: Fine-loamy, mixed, mesic Mollic Hapludalfs

Typical Pedon

Koronis loam, 2 to 6 percent slopes, 1,055 feet west and 2,400 feet north of the southeast corner of sec. 34, T. 121 N., R. 31 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure; friable; 3 percent gravel; 2 percent cobbles and stones; slightly acid; abrupt smooth boundary.

Bt1—8 to 17 inches; dark brown (10YR 4/3) loam; moderate fine and medium subangular blocky structure; friable; many thin dark brown (10YR 3/3) clay films on faces of peds; 4 percent gravel; 3 percent cobbles and stones; slightly acid; clear smooth boundary.

Bt2—17 to 26 inches; dark yellowish brown (10YR 4/4) fine sandy loam; weak medium prismatic structure parting to moderate medium subangular blocky; friable; many thin dark brown (10YR 3/3) clay films on faces of peds; 5 percent gravel; 4 percent cobbles and stones; moderately acid; clear smooth boundary.

Bt3—26 to 31 inches; yellowish brown (10YR 5/4) fine sandy loam; moderate coarse prismatic structure parting to moderate medium subangular blocky; friable; many moderately thick dark brown (10YR 3/3) clay films on vertical faces of peds and common thin brown (10YR 4/3) clay films on faces of peds; 5 percent gravel; 4 percent cobbles and stones; neutral; clear wavy boundary.

Bk1—31 to 35 inches; light olive brown (2.5Y 5/4) fine sandy loam; few fine prominent strong brown (7.5YR 5/6) remnant iron concentrations; weak coarse prismatic structure parting to weak medium subangular blocky; very friable; few moderately thick dark brown (10YR 4/3) clay films on vertical prism faces and common moderately thick dark brown (10YR 3/3) clay films in tubular pores; 8 percent gravel; 5 percent cobbles and stones; strongly effervescent; slightly alkaline; clear wavy boundary.

Bk2—35 to 43 inches; light olive brown (2.5Y 5/4) fine sandy loam; few fine prominent yellowish red (5YR 4/8) remnant iron concentrations; weak medium subangular blocky structure; very friable; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 8 percent gravel; 6 percent cobbles and stones; strongly effervescent; moderately alkaline; clear smooth boundary.

C—43 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam; common fine distinct strong brown (7.5YR 5/6) remnant iron concentrations; weak thick platy structure; very friable; 8 percent gravel; 6 percent cobbles and stones; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to carbonates: 16 to 36 inches
Thickness of the mollic epipedon: 5 to 9 inches

A horizon:
Hue—10YR
Value—3 moist; 5 or 6 dry
Chroma—1 or 2
Texture—loam, sandy loam, or fine sandy loam
Content of rock fragments—1 to 3 percent gravel; 1 to 3 percent cobbles and stones

Bt horizon:
Hue—10YR, 7.5YR, or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—sandy clay loam, loam, fine sandy loam, or sandy loam
Content of rock fragments—4 to 8 percent gravel; 3 to 5 percent cobbles and stones

Bk or C horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—loam, sandy loam, or fine sandy loam
Content of rock fragments—6 to 10 percent gravel; 4 to 6 percent cobbles and stones

461B—Koronis loam, 2 to 6 percent slopes

Composition

Koronis and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.4 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Uniongrove and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

461C2—Koronis loam, 6 to 12 percent slopes, eroded

Composition

Koronis and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 6 to 12 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.3 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Forestcity and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

804B—Koronis-Sunburg-Hawick complex, 2 to 6 percent slopes

Composition

Koronis and similar soils: About 50 percent
Sunburg and similar soils: About 20 percent
Hawick and similar soils: About 15 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Koronis—summits and backslopes; Sunburg and Hawick—shoulders and summits
Slope range: Koronis—2 to 6 percent; Sunburg—4 to 6 percent; Hawick—2 to 6 percent

Component Description

Koronis

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.6 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Sunburg

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Hawick

Surface layer texture: Gravelly loamy sand
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.8 inches (low)
Content of organic matter in the surface layer: About 2 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Uniongrove and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

804C2—Koronis-Sunburg-Hawick complex, 6 to 12 percent slopes, eroded

Composition

Koronis and similar soils: About 45 percent
Sunburg and similar soils: About 25 percent
Hawick and similar soils: About 15 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Koronis—summits and backslopes; Sunburg and Hawick—shoulders and summits
Slope range: 6 to 12 percent

Component Description

Koronis

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.9 inches (moderate)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Sunburg

Surface layer texture: Sandy loam

Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Hawick

Surface layer texture: Gravelly sand
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.0 inches (low)
Content of organic matter in the surface layer: About 2 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Forestcity and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

804D2—Koronis-Sunburg-Hawick complex, 12 to 18 percent slopes, eroded

Composition

Koronis and similar soils: About 40 percent
Sunburg and similar soils: About 35 percent
Hawick and similar soils: About 15 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Koronis—backslopes; Sunburg and Hawick—backslopes and shoulders
Slope range: 12 to 18 percent

Component Description

Koronis

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.9 inches (moderate)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Sunburg

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Hawick

Surface layer texture: Gravelly sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.0 inches (low)
Content of organic matter in the surface layer: About 2 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Forestcity and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

804E—Koronis-Sunburg-Hawick complex, 18 to 40 percent slopes

Composition

Koronis and similar soils: About 50 percent
Sunburg and similar soils: About 25 percent
Hawick and similar soils: About 15 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Koronis—backslopes; Sunburg and Hawick—backslopes and shoulders
Slope range: 18 to 40 percent

Component Description

Koronis

Surface layer texture: Fine sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.8 inches (moderate)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Sunburg

Surface layer texture: Fine sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Hawick

Surface layer texture: Gravelly loamy sand
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.1 inches (low)
Content of organic matter in the surface layer: About 2 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Forestcity and similar soils

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

807D2—Koronis-Sunburg complex, 12 to 18 percent slopes, eroded

Composition

Koronis and similar soils: About 80 percent
Sunburg and similar soils: About 15 percent
Inclusions: About 5 percent

Setting

Landform: Moraines
Position on the landform: Koronis—backslopes; Sunburg—backslopes and shoulders
Slope range: 12 to 18 percent

Component Description

Koronis

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.8 inches (moderate)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Sunburg

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches

Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Forestcity and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Lester Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 6 to 40 percent
Taxonomic classification: Fine-loamy, mixed, mesic Mollic Hapludalfs

Typical Pedon

Lester loam, 6 to 12 percent slopes, eroded (fig. 15), 200 feet east and 700 feet north of the southwest corner of sec. 2, T. 118 N., R. 30 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; about 1 percent gravel; slightly acid; abrupt smooth boundary.

Bt1—9 to 19 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; firm; many brown or dark brown (10YR 4/3) organic coatings on faces of peds; common dark brown (10YR 3/3) clay films on faces of peds and in pores; about 1 percent gravel; moderately acid; clear smooth boundary.

Bt2—19 to 27 inches; yellowish brown (10YR 5/4) clay loam; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; friable; many brown or dark brown (10YR 4/3) organic coatings on faces of peds; few dark brown (10YR 3/3) clay films on faces of peds and in pores; about 2 percent gravel; about 1 percent cobbles and stones; moderately acid; clear wavy boundary.

Bk—27 to 60 inches; light olive brown (2.5Y 5/4) loam; weak coarse subangular blocky structure parting to weak medium platy; friable; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; about 3 percent gravel; about 1 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 36 inches
Thickness of the mollic epipedon: 7 to 10 inches

A horizon:
Hue—10YR
Value—3 moist; 5 or 6 dry
Chroma—1 or 2
Texture—loam or clay loam
Content of rock fragments—2 to 4 percent gravel; 0 to 1 percent cobbles and stones

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—loam or clay loam
Content of rock fragments—1 to 4 percent gravel; 1 to 2 percent cobbles and stones

Bk horizon:
Hue—2.5Y
Value—4 to 6
Chroma—4
Texture—loam
Content of rock fragments—1 to 4 percent gravel; 1 to 4 percent cobbles and stones

106C2—Lester loam, 6 to 12 percent slopes, eroded

Composition

Lester and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 6 to 12 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cordova and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

945D2—Lester-Storden complex, 12 to 18 percent slopes, eroded

Composition

Lester and similar soils: About 70 percent
Storden and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Lester—backslopes; Storden—backslopes and shoulders
Slope range: 12 to 18 percent

Component Description

Lester

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Storden

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hamel and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

945E—Lester-Storden complex, 18 to 40 percent slopes

Composition

Lester and similar soils: About 70 percent
Storden and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Lester—backslopes; Storden—backslopes and shoulders
Slope range: 18 to 40 percent

Component Description

Lester

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.3 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Storden

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hamel and similar soils

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Le Sueur Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 1 to 3 percent
Taxonomic classification: Fine-loamy, mixed, mesic Aquic Argiudolls

Typical Pedon

Le Sueur clay loam, 1 to 3 percent slopes, 1,100 feet west and 175 feet south of the northeast corner of sec. 24, T. 118 N., R. 29 W.

Ap—0 to 11 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; cloddy; friable; 1 percent gravel; slightly acid; clear smooth boundary.

AE—11 to 14 inches; very dark brown (10YR 2/2) clay loam, dark gray (10YR 4/1) dry; weak fine angular blocky structure; friable; 1 percent gravel; slightly acid; clear smooth boundary.

BE—14 to 18 inches; dark grayish brown (2.5Y 4/2) clay loam; weak fine angular blocky structure; friable; very many very dark grayish brown (2.5Y 3/2) organic coatings on faces of peds and in pores; 2 percent gravel; 1 percent cobbles and stones; neutral; clear smooth boundary.

Bt1—18 to 28 inches; dark grayish brown (2.5Y 4/2) clay loam; moderate medium prismatic structure parting to moderate coarse angular blocky; friable; few fine faint light brownish gray (2.5Y 6/2) iron depletions; few very dark grayish brown (2.5Y 3/2) clay films on faces of peds; 2 percent gravel; 2 percent cobbles and stones; slightly acid; clear smooth boundary.

Bt2—28 to 33 inches; grayish brown (2.5Y 5/2) clay loam; weak coarse prismatic structure parting to weak very coarse angular blocky; friable; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; few very dark grayish brown (2.5Y 3/2) clay films on faces of peds; 2 percent gravel; 3 percent cobbles and stones; slightly acid; clear smooth boundary.

Bk1—33 to 40 inches; light brownish gray (2.5Y 6/2) loam; weak coarse prismatic structure parting to weak very coarse angular blocky; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—40 to 60 inches; light brownish gray (2.5Y 6/2) loam; weak coarse subangular blocky structure; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 28 to 45 inches
Thickness of the mollic epipedon: 10 to 18 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—clay loam
Content of rock fragments—1 to 3 percent gravel; 0 to 2 percent cobbles and stones

Bt horizon:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—clay loam or loam
Content of rock fragments—1 to 2 percent gravel; 2 to 4 percent cobbles and stones

Bk horizon:
Hue—5Y or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam
Content of rock fragments—2 to 4 percent gravel; 1 to 4 percent cobbles and stones

239—Le Sueur clay loam, 1 to 3 percent slopes

Composition

Le Sueur and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 1 to 3 percent

Component Description

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)
Content of organic matter in the surface layer: About 5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cordova and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Litchfield Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Rapid
Landform: Outwash plains and terraces
Parent material: Glacial outwash
Slope range: 0 to 2 percent
Taxonomic classification: Sandy, mixed, mesic Aquic Hapludolls

Typical Pedon

Litchfield loamy fine sand, 0 to 2 percent slopes, 1,080 feet west and 1,280 feet south of the northeast corner of sec. 9, T. 119 N., R. 30 W.

Ap—0 to 9 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

A—9 to 14 inches; very dark gray (10YR 3/1) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; slightly acid; clear smooth boundary.

AB—14 to 20 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; very friable; slightly acid; clear smooth boundary.

Bw—20 to 33 inches; dark grayish brown (10YR 4/2) fine sand; weak medium subangular blocky structure; very friable; few fine faint grayish brown (10YR 5/2) iron depletions; slightly acid; clear smooth boundary.

BC—33 to 40 inches; light olive brown (2.5Y 5/4) and grayish brown (2.5Y 5/2) very fine sandy loam; weak medium subangular blocky structure; very friable; few fine distinct light olive brown (2.5Y 5/6) iron concentrations; few thin seams of loamy fine sand; slightly acid; clear wavy boundary.

Cg—40 to 60 inches; olive gray (5Y 5/2) and olive (5Y 5/3) loamy fine sand; many fine prominent dark reddish brown (5YR 3/3) iron oxide stains; massive; very friable; few thin seams of fine sand; slightly acid.

Range in Characteristics

Depth to carbonates: Greater than 50 inches
Thickness of the mollic epipedon: 10 to 24 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy fine sand or sandy loam

Bw horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 to 4
Texture—fine sand or loamy fine sand with strata of very fine sand, loamy very fine sand, fine sandy loam, and very fine sandy loam; loamy sand or sand included when the content of coarse sand is less than 10 percent and the content of very coarse sand is less than 5 percent; strata of sandy clay loam or fine sandy loam in some pedons

Cg horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—1 to 3
Texture—sand, fine sand, loamy sand, or loamy fine sand

181—Litchfield loamy fine sand, 0 to 2 percent slopes

Composition

Litchfield and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loamy fine sand
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 6.3 inches (moderate)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Dassel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1176—Litchfield sandy loam, 0 to 2 percent slopes

Composition

Litchfield and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 5.6 inches (low)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Dassel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Lundlake Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately rapid
Landform: Moraines
Parent material: Till
Slope range: 0 to 1 percent
Taxonomic classification: Fine-loamy, mixed, mesic Cumulic Endoaquolls

Typical Pedon

Lundlake silty clay loam, in an area of Swedegrove-Lundlake, depressional, complex, 0 to 2 percent slopes, 800 feet north and 525 feet west of the southeast corner of sec. 20, T. 121 N., R. 31 W.

Ap—0 to 12 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak very fine subangular blocky structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.

A1—12 to 22 inches; black (N 2/0) loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure parting to moderate very fine subangular blocky; friable; about 1 percent gravel; neutral; clear smooth boundary.

A2—22 to 28 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to moderate very fine subangular blocky; friable; about 1 percent gravel; neutral; clear smooth boundary.

AB—28 to 36 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to moderate very fine subangular blocky; friable; about 1 percent gravel; neutral; clear smooth boundary.

2Bg1—36 to 45 inches; olive gray (5Y 5/2) sandy loam; weak coarse subangular blocky structure; friable; few fine distinct light olive (5Y 5/4) iron concentrations; about 2 percent gravel; about 5 percent cobbles; neutral; clear smooth boundary.

2Bg2—45 to 60 inches; light olive gray (5Y 6/2) sandy loam; weak coarse subangular blocky structure; very friable; few fine distinct olive (5Y 5/4) iron concentrations; about 2 percent gravel; about 7 percent cobbles; neutral.

Range in Characteristics

Depth to carbonates: 30 to more than 60 inches
Thickness of the mollic epipedon: 24 to 48 inches
Other features: A 2Bkg or 2Cg horizon in some pedons

Ap horizon:
Hue—neutral, 5Y, or 10YR
Value—2 or 3
Chroma—0 to 2
Texture—silty clay loam, loam, or mucky loam
Content of rock fragments—1 to 3 percent gravel; 0 to 3 percent cobbles and stones

A horizon:
Hue—neutral, 5Y, or 10YR
Value—2 or 3
Chroma—0 to 3
Texture—loam, mucky loam, silty clay loam, or clay loam
Content of rock fragments—1 to 3 percent gravel; 0 to 3 percent cobbles and stones

Bg horizon:
Hue—5Y
Value—4 to 6
Chroma—1 or 2
Texture—loam or sandy clay loam
Content of rock fragments—3 to 6 percent gravel; 3 to 6 percent cobbles and stones

2Bg horizon:
Hue—5Y
Value—4 to 6
Chroma—1 or 2
Texture—fine sandy loam, sandy loam, or loam
Content of rock fragments—4 to 8 percent gravel; 4 to 8 percent cobbles and stones

1165—Lundlake silty clay loam, depressional, 0 to 1 percent slopes

Composition

Lundlake and similar soils: About 85 percent

Inclusions: About 15 percent

Setting

Landform: Depressions on moraines
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 80 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter in the surface layer: About 8.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Swedegrove and similar soils
- Grovecity and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Lura Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Slow
Landform: Lake plains and moraines
Parent material: Lacustrine deposits
Slope range: 0 to 1 percent
Taxonomic classification: Fine, montmorillonitic, mesic Cumulic Vertic Epiaquolls
Taxadjunct features: The Lura soils in this survey area are taxadjuncts because they have carbonates at a depth of less than 40 inches.

Typical Pedon

Lura silty clay, depressional, 0 to 1 percent slopes, 250 feet south and 1,500 feet east of the northwest corner of sec. 25, T. 117 N., R. 32 W.

Ap—0 to 9 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; cloddy; firm; neutral; clear smooth boundary.

A1—9 to 13 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; moderate fine angular blocky structure parting to strong very fine angular blocky; friable; neutral; clear smooth boundary.

A2—13 to 24 inches; black (5Y 2.5/1) silty clay, very dark gray (5Y 3/1) dry; moderate medium angular blocky structure parting to strong very fine angular blocky; friable; very many stress surfaces on faces of peds; neutral; clear wavy boundary.

Bg—24 to 31 inches; olive gray (5Y 4/2) silty clay; weak medium prismatic structure parting to strong very fine angular blocky; friable; very many stress surfaces on faces of peds; common very dark gray (5Y 3/1) organic coatings on faces of peds and in pores; neutral; clear smooth boundary.

Bkg1—31 to 36 inches; gray (5Y 5/1) silty clay; weak fine prismatic structure parting to moderate very fine angular blocky; friable; few stress surfaces on faces of peds; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg2—36 to 60 inches; gray (5Y 5/1) silty clay; moderate very fine angular blocky structure; friable; common medium prominent light olive brown (2.5Y 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to more than 60 inches
Thickness of the mollic epipedon: 24 to 60 inches

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 in the upper part, 3 in the lower part
Chroma—0 or 1
Texture—silty clay

Bg horizon:
Hue—5Y
Value—4
Chroma—1 or 2

Texture—silty clay, clay, or silty clay loam

Bkg horizon:
Hue—5Y or 5GY
Value—4 to 6
Chroma—1 or 2
Texture—clay, silty clay, or silty clay loam
Content of rock fragments—0 to 2 percent gravel; 0 to 1 percent cobbles and stones

211—Lura silty clay, depressional, 0 to 1 percent slopes

Composition

Lura and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Depressions on lake plains and moraines
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Lacustrine deposits
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)
Content of organic matter in the surface layer: About 8 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Corvuso and similar soils
- Cosmos and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Madelia Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Lake plains
Parent material: Lacustrine deposits
Slope range: 0 to 2 percent
Taxonomic classification: Fine-silty, mixed, mesic Typic Endoaquolls

Typical Pedon

Madelia silty clay loam, 0 to 2 percent slopes, 1,000 feet south and 100 feet west of the northeast corner of sec. 29, T. 120 N., R. 29 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.
A—10 to 16 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to moderate very fine angular blocky; friable; neutral; clear smooth boundary.
Bg1—16 to 21 inches; olive gray (5Y 5/2) silt loam; weak medium subangular blocky structure; friable; many fine prominent light olive brown (2.5Y 5/6) iron concentrations; very many olive gray (5Y 4/2) organic coatings on faces of peds and in pores; neutral; clear smooth boundary.
Bg2—21 to 30 inches; olive gray (5Y 5/2) silt loam; weak medium subangular blocky structure parting to weak thin platy; friable; many fine prominent light olive brown (2.5Y 5/6) iron concentrations; neutral; abrupt smooth boundary.
Bkg—30 to 60 inches; light olive gray (5Y 6/2) silt loam; moderate thin platy structure; friable; many medium prominent light olive brown (2.5Y 5/6) iron concentrations; common fine irregular white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Thickness of the mollic epipedon: 14 to 24 inches

A horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam

Bg horizon:
Hue—5Y or 2.5Y

Value—4 or 5
Chroma—1 or 2
Texture—silty clay loam or silt loam

Bkg horizon:
Hue—5Y
Value—5 or 6
Chroma—1 or 2
Texture—silt loam, silty clay loam, or loam that has a high content of very fine sand

136—Madelia silty clay loam, 0 to 2 percent slopes

Composition

Madelia and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on lake plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.7 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Okoboji and similar soils
- Spicer and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Marcellon Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately rapid
Landform: Moraines
Parent material: Till
Slope range: 0 to 3 percent
Taxonomic classification: Fine-loamy, mixed, mesic Aquic Argiudolls

Typical Pedon

Marcellon loam, 0 to 3 percent slopes, 650 feet west and 1,400 feet south of the northeast corner of sec. 8, T. 121 N., R. 30 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; 1 percent gravel; 1 percent cobbles and stones; neutral; clear smooth boundary.

A—10 to 13 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; 2 percent gravel; 1 percent cobbles and stones; slightly acid; clear smooth boundary.

Bt1—13 to 19 inches; dark grayish brown (2.5Y 4/2) loam; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; very many dark grayish brown (2.5Y 4/2) organic coatings on faces of peds; 5 percent gravel; 3 percent cobbles and stones; moderately acid; clear smooth boundary.

Bt2—19 to 27 inches; grayish brown (2.5Y 5/2) loam; weak medium prismatic structure parting to moderate fine subangular blocky; friable; very many dark grayish brown (2.5Y 4/2) organic coatings on faces of peds; common very dark grayish brown (2.5Y 3/2) clay films on faces of peds and in pores; 7 percent gravel; 4 percent cobbles and stones; moderately acid; clear smooth boundary.

Bt3—27 to 32 inches; light olive brown (2.5Y 5/6) loam; moderate medium subangular blocky structure parting to moderate fine subangular blocky; friable; common fine prominent olive gray (5Y 4/2) iron depletions; common black (10YR 2/1) clay films on faces of peds and in pores; 8 percent gravel; 5 percent cobbles and stones; neutral; clear smooth boundary.

Bk1—32 to 38 inches; light brownish gray (2.5Y 6/2) loam; weak medium subangular blocky structure; friable; common medium distinct light yellowish brown (2.5Y 6/4) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 8 percent gravel; 6 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—38 to 60 inches; light brownish gray (2.5Y 6/2) sandy loam; weak medium subangular blocky structure; friable; common medium distinct light yellowish brown (2.5Y 6/4) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 8 percent gravel; 6 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 24 to 40 inches
Thickness of the mollic epipedon: 10 to 18 inches
Other features: A thin E or BA horizon in some pedons

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 to 3
Texture—loam
Content of rock fragments—1 to 3 percent gravel; 1 to 3 percent cobbles and stones

Bt horizon:
Hue—2.5Y or 10YR
Value—4 or 5
Chroma—2 to 4
Texture—loam or sandy clay loam
Content of rock fragments—3 to 7 percent gravel; 3 to 5 percent cobbles and stones

Bk horizon:
Hue—10YR or 2.5Y
Value—5 or 6
Chroma—2 or 3
Texture—sandy loam or loam
Content of rock fragments—4 to 8 percent gravel; 4 to 8 percent cobbles and stones

511—Marcellon loam, 0 to 3 percent slopes

Composition

Marcellon and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 0 to 3 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 1.0 to 2.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.5 inches (moderate)
Content of organic matter in the surface layer: About 5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Uniongrove and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Mayer Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate in the loamy mantle and rapid in the underlying sand and gravel
Landform: Outwash plains and terraces
Parent material: Glacial outwash
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic Typic Endoaquolls

Typical Pedon

Mayer loam, in an area of Mayer-Biscay, depressional, complex, 0 to 2 percent slopes, 800 feet east and 100 feet south of the northwest corner of sec. 21, T. 119 N., R. 30 W.

Ap—0 to 8 inches; black (N 2/0) loam; weak fine subangular blocky structure; friable; 1 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

A—8 to 16 inches; black (N 2/0) loam; weak fine subangular blocky structure; friable; 1 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg1—16 to 21 inches; dark grayish brown (2.5Y 4/2) loam; weak fine subangular blocky structure; friable; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 10 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg2—21 to 25 inches; olive gray (5Y 5/2) loam; weak fine subangular blocky structure; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 8 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

2Bkg3—25 to 60 inches; olive gray (5Y 5/2) gravelly sand; single grain; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; 25 percent gravel; common fine soft white (10YR 8/2) accumulations of calcium carbonate on the underside of gravel and very coarse sand fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface
Thickness of the loamy mantle: 20 to 40 inches
Thickness of the mollic epipedon: 14 to 24 inches

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loam
Content of rock fragments—0 to 5 percent gravel

Bkg horizon:
Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam or clay loam
Content of rock fragments—0 to 10 percent gravel

2Bkg horizon:
Hue—5Y
Value—3 to 5
Chroma—1 to 3
Texture—coarse sand, gravelly coarse sand, sand, or gravelly sand
Content of rock fragments—10 to 50 percent gravel

1097—Mayer-Biscay, depressional, complex, 0 to 2 percent slopes

Composition

Mayer and similar soils: About 70 percent
Biscay and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Mayer—flats and swales; Biscay—depressions
Slope range: Mayer—0 to 2 percent; Biscay—0 to 1 percent

Component Description

Mayer

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 6.0 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

Biscay

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 6.5 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Minneopa and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Medo Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderate in the organic material and moderately rapid or rapid in the underlying material
Landform: Outwash plains and terraces
Parent material: Organic materials over glacial outwash
Slope range: 0 to 1 percent
Taxonomic classification: Loamy, mixed, euic, mesic Terric Medisaprists

Typical Pedon

Medo muck, depressional, 0 to 1 percent slopes, 1,700 feet south and 650 feet west of the northeast corner of sec. 15, T. 119 N., R. 30 W.

Oa—0 to 24 inches; muck (sapric material), black (N 2/0) broken face and rubbed; about 20 percent fiber, trace rubbed; weak fine subangular blocky structure; very friable; common fine roots; neutral; abrupt smooth boundary.
2A1—24 to 29 inches; black (N 2/0) silt loam; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.
2A2—29 to 42 inches; black (N 2/0) silty clay loam; weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.
2Bw—42 to 56 inches; very dark gray (5Y 3/1) sandy loam; weak very fine subangular blocky structure; friable; neutral; abrupt smooth boundary.
2Cg—56 to 60 inches; dark gray (5Y 4/1) sand; single grain; loose; neutral.

Range in Characteristics

Depth to mineral soil: 16 to 40 inches

O horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—muck

2A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—sandy loam, fine sandy loam, loam, silt loam, or silty clay loam

2Cg horizon:
Hue—5Y or 5GY
Value—4 to 6
Chroma—1 or 2
Texture—sand, fine sand, very fine sand, coarse sand, or the loamy or gravelly analogs of these textures

548—Medo muck, depressional, 0 to 1 percent slopes

Composition

Medo and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Depressions on outwash plains
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials over glacial outwash
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 15.1 inches (high)
Content of organic matter in the surface layer: About 35 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Dassel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1406—Medo, Dassel, and Biscay soils, ponded, 0 to 1 percent slopes

Composition

Medo and similar soils: About 30 percent
Dassel and similar soils: About 30 percent
Biscay and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Depressions on outwash plains and terraces
Slope range: 0 to 1 percent

Component Description

Medo

Surface layer texture: Muck
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials over glacial outwash
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 12.0 inches (high)
Content of organic matter in the surface layer: About 35 percent (very high)

Dassel

Surface layer texture: Fine sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Glaciolacustrine deposits or glacial outwash
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 7.6 inches (moderate)
Content of organic matter in the surface layer: About 9 percent (very high)

Biscay

Surface layer texture: Mucky loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Glacial outwash
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 6.5 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Houghton and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Minneopa Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate or moderately rapid in the loamy mantle and rapid or very rapid in the underlying sand and gravel
Landform: Outwash plains and terraces
Parent material: Glacial outwash
Slope range: 0 to 2 percent
Taxonomic classification: Sandy, mixed, mesic Aquic Hapludolls

Typical Pedon

Minneopa loam, 0 to 2 percent slopes, 500 feet east and 150 feet north of the southwest corner of sec. 12, T. 120 N., R. 31 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

A—7 to 11 inches; very dark brown (10YR 2/2) sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; very many black (10YR 2/1) organic coatings on faces of peds; slightly acid; clear smooth boundary.

BA—11 to 15 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; very many dark brown (10YR 2/2) organic coatings on faces of peds; slightly acid; clear smooth boundary.

2Bw—15 to 18 inches; olive brown (2.5Y 4/3) loamy sand; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; very many dark grayish brown (10YR 4/2) organic coatings on faces of peds; 12 percent gravel; neutral; clear smooth boundary.

2BC—18 to 25 inches; olive brown (2.5Y 4/3) gravelly loamy sand; common fine faint grayish brown (2.5Y 5/2) iron depletions and light olive brown (2.5Y 5/4) iron concentrations; weak very fine subangular blocky structure; very friable; 20 percent gravel; neutral; clear smooth boundary.

2Bk1—25 to 34 inches; grayish brown (2.5Y 5/2) gravelly loamy sand; common fine distinct light olive brown (2.5Y 5/4) iron concentrations; weak very fine subangular blocky structure; very friable; soft white (10YR 8/2) accumulations of calcium carbonate on underside of gravel and very coarse sand fragments; 25 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

2Bk2—34 to 60 inches; grayish brown (2.5Y 5/2) gravelly sand; common fine distinct light olive brown (2.5Y 5/6) iron concentrations; single grain; loose; common soft white (10YR 8/2) accumulations of calcium carbonate on underside of gravel and very coarse sand fragments; 25 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 25 inches
Thickness of the loamy mantle: 12 to 20 inches
Thickness of the mollic epipedon: 12 to 20 inches
Other features: A Bw horizon in some pedons

Ap horizon:
Hue—10YR
Value—2
Chroma—1 or 2
Texture—loam
Content of rock fragments—0 to 10 percent gravel

A horizon:
Hue—10YR or 2.5Y
Value—2 or 3
Chroma—1 or 2
Texture—sandy loam or loam
Content of rock fragments—0 to 10 percent gravel

2Bw and 2BC horizons:
Hue—10YR or 2.5Y
Value—3 to 5
Chroma—2 to 4
Texture—coarse sand, sand, loamy coarse sand, loamy sand, or the gravelly analogs of these textures
Content of rock fragments—5 to 35 percent gravel

2Bk horizon:
Hue—10YR or 2.5Y
Value—3 or 4
Chroma—2 to 4
Texture—coarse sand, sand, loamy coarse sand, loamy sand, or the gravelly analogs of these textures
Content of rock fragments—5 to 35 percent gravel

1384—Minneopa loam, 0 to 2 percent slopes

Composition

Minneopa and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: 3 to 5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 4.7 inches (low)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils
- Estherville and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Muskego Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately rapid in the peaty muck; moderate or slow in the coprogenous earth
Landform: Moraines, flood plains, lake plains, and outwash plains
Parent material: Organic materials and coprogenous earth
Slope range: 0 to 1 percent
Taxonomic classification: Coprogenous, euic, mesic Limnic Medisaprists

Typical Pedon

Muskego muck, depressional, 0 to 1 percent slopes (fig. 16), 2,150 feet north and 2,000 feet west of the southeast corner of sec. 2, T. 117 N., R. 31 W.

Op—0 to 10 inches; muck (sapric material), black (10YR 2/1) broken faced and rubbed; about 10 percent fiber, trace rubbed; weak fine granular structure; very friable; neutral; clear smooth boundary.

Oa1—10 to 30 inches; muck (sapric material), very dark brown (10YR 2/2) broken face, black (10YR 2/1) rubbed; about 10 percent fiber, trace rubbed; weak thick platy structure parting to weak medium subangular blocky; very friable; neutral; clear smooth boundary.

Oa2—30 to 40 inches; muck (sapric material), black (10YR 2/1) broken face and rubbed; about 10 percent fiber, trace rubbed; weak thick platy structure parting to weak medium subangular blocky; very friable; neutral; abrupt smooth boundary.

C—40 to 60 inches; black (10YR 2/1) mucky silt loam (coprogenous earth); massive; very friable; 5 percent snail shells and shell fragments; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to coprogenous earth: 16 to 50 inches

O horizon:
Hue—neutral, 10YR, or 7.5YR
Value—2 or 3
Chroma—0 to 3
Texture—muck

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—2 to 4
Chroma—1 or 2
Texture—mucky silt loam (coprogenous earth)
Content of rock fragments—5 percent snail shells

525—Muskego muck, depressional, 0 to 1 percent slopes

Composition

Muskego and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Depressions on lake plains, outwash plains, and moraines
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Muck
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials and coprogenous earth
Flooding: None
Seasonal high water table: 1 foot above to 1 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 20.2 inches (high)
Content of organic matter in the surface layer: About 75 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Blue Earth and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1173—Muskego and Klossner soils, depressional, 0 to 1 percent slopes, frequently flooded

Composition

Muskego and similar soils: About 45 percent
Klossner and similar soils: About 40 percent
Inclusions: About 15 percent

Setting

Landform: Flats and swales on flood plains
Slope range: 0 to 1 percent

Component Description

Muskego

Surface layer texture: Muck
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials and coprogenous earth
Flooding: Frequent
Seasonal high water table: 3.0 feet above to 1.5 feet below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 21.4 inches (high)
Content of organic matter in the surface layer: About 75 percent (very high)

Klossner

Surface layer texture: Muck
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials over glaciolacustrine deposits or till
Flooding: Frequent
Seasonal high water table: 1 foot above to 1 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 17.7 inches (high)
Content of organic matter in the surface layer: About 42.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Calco and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1203—Muskego, Blue Earth, and Houghton soils, ponded

Composition

Muskego and similar soils: About 30 percent
Blue Earth and similar soils: About 30 percent
Houghton and similar soils: About 30 percent
Inclusions: About 10 percent

Setting

Landform: Depressions on moraines
Slope range: 0 to 1 percent

Component Description

Muskego

Surface layer texture: Muck
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials and coprogenous earth
Flooding: None
Seasonal high water table: 3 feet above to 1 foot below the surface
Kind of water table: Apparent
Ponding duration: Long
Available water capacity to 60 inches or root-limiting layer: About 13.3 inches (high)
Content of organic matter in the surface layer: About 42.5 percent (very high)

Blue Earth

Surface layer texture: Mucky silt loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Coprogenous earth
Flooding: None
Seasonal high water table: At the surface to 3 feet above the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 12.6 inches (high)
Content of organic matter in the surface layer: About 17.5 percent (very high)

Houghton

Surface layer texture: Muck
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Organic materials
Flooding: None
Seasonal high water table: 2.0 feet above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 24.0 inches (high)
Content of organic matter in the surface layer: About 84.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Okoboji and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Newlondon Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Moraines
Parent material: Till
Slope range: 6 to 18 percent
Taxonomic classification: Fine-loamy, mixed, mesic Aquic Eutrochrepts

Typical Pedon

Newlondon clay loam, in an area of Newlondon-Strout complex, 6 to 12 percent slopes, eroded, 700 feet south and 150 feet west of the northeast corner of sec. 23, T. 118 N., R. 32 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) clay loam; cloddy; friable; 1 percent gravel; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—7 to 14 inches; light yellowish brown (2.5Y 6/4) clay loam; strong medium angular blocky structure parting to strong very fine angular blocky; firm; common medium prominent yellowish brown (10YR 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 2 percent gravel; 1 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—14 to 38 inches; grayish brown (2.5Y 5/2) clay loam; moderate medium prismatic structure parting to moderate fine angular blocky; firm; common medium prominent yellowish brown (10YR 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 2 percent gravel; 2 percent cobbles and stones; strongly effervescent; slightly alkaline; gradual smooth boundary.

C—38 to 60 inches; grayish brown (2.5Y 5/2) clay loam; weak coarse angular blocky structure; very firm; common medium prominent yellowish brown (10YR 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 2 percent gravel; 2 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Ap horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—2 or 3
Texture—clay loam
Content of rock fragments—1 to 2 percent gravel; 0 to 1 percent cobbles and stones

Bk horizon:
Hue—2.5Y

Value—4 to 6
Chroma—3 or 4
Texture—clay, silty clay, or clay loam
Content of rock fragments—2 to 4 percent gravel; 1 to 3 percent cobbles and stones

1171C—Newlondon-Strout complex, 6 to 12 percent slopes, eroded

Composition

Newlondon and similar soils: About 65 percent
Strout and similar soils: About 30 percent
Inclusions: About 5 percent

Setting

Landform: Moraines
Position on the landform: Newlondon—shoulders and summits; Strout—summits and backslopes
Slope range: 6 to 12 percent

Component Description

Newlondon

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.7 inches (high)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

Strout

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 8.2 inches (moderate)
Content of organic matter in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Danielson and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1171D—Newlondon-Strout complex, 12 to 18 percent slopes, eroded

Composition

Newlondon and similar soils: About 80 percent
Strout and similar soils: About 15 percent
Inclusions: About 5 percent

Setting

Landform: Moraines
Position on the landform: Newlondon—backslopes and shoulders; Strout—backslopes
Slope range: 12 to 18 percent

Component Description

Newlondon

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.7 inches (high)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

Strout

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 8.1 inches (moderate)
Content of organic matter in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Danielson and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Nicollet Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 1 to 3 percent
Taxonomic classification: Fine-loamy, mixed, mesic Aquic Hapludolls

Typical Pedon

Nicollet clay loam, 1 to 3 percent slopes, 100 feet east and 1,950 feet north of the southwest corner of sec. 29, T. 119 N., R. 31 W.

Ap—0 to 10 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; 1 percent gravel; 1 percent cobbles; neutral; abrupt smooth boundary.

A1—10 to 13 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; 1 percent gravel; 1 percent cobbles; neutral; clear smooth boundary.

A2—13 to 16 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; 1 percent gravel; 1 percent cobbles; neutral; clear smooth boundary.

Bw1—16 to 25 inches; dark grayish brown (2.5Y 4/2) clay loam; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; 2 percent gravel; 2 percent cobbles; neutral; clear smooth boundary.

Bw2—25 to 30 inches; dark grayish brown (2.5Y 4/2) loam; weak medium subangular blocky structure; friable; few fine faint light brownish gray (2.5Y 6/2) iron depletions; 2 percent gravel; 2 percent cobbles; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk1—30 to 37 inches; grayish brown (2.5Y 5/2) loam; massive; friable; few fine faint light brownish gray (2.5Y 6/2) iron depletions and few prominent yellowish brown (10YR 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 3 percent cobbles; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—37 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; common medium distinct light brownish gray (2.5Y 6/2) iron depletions and common distinct yellowish brown (10YR 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 3 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 30 inches
Thickness of the mollic epipedon: 10 to 24 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—clay loam or silty clay loam
Content of rock fragments—1 to 4 percent gravel; 0 to 1 percent cobbles and stones

Bw horizon:
Hue—10YR or 2.5Y
Value—3 or 4
Chroma—2 to 4
Texture—loam, clay loam, or silty clay loam in the upper part
Content of rock fragments—1 to 4 percent gravel; 1 to 4 percent cobbles and stones

Bk horizon:
Hue—2.5Y or 5Y
Value—5 or 6
Chroma—2 to 4
Texture—loam or clay loam

Content of rock fragments—2 to 4 percent gravel; 1 to 4 percent cobbles and stones

130—Nicollet clay loam, 1 to 3 percent slopes

Composition

Nicollet and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 1 to 3 percent

Component Description

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.0 to 3.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1100—Nicollet silty clay loam, 1 to 3 percent slopes

Composition

Nicollet and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Rises on moraines
Slope range: 1 to 3 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Lacustrine deposits over till
Flooding: None
Depth to the water table: 2.0 to 3.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.4 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Webster and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Okoboji Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Moderately slow
Landform: Moraines and lake plains
Parent material: Lacustrine deposits over till
Slope range: 0 to 1 percent
Taxonomic classification: Fine, montmorillonitic, mesic Cumulic Vertic Endoaquolls

Typical Pedon

Okoboji silty clay loam, in an area of Harps-Okoboji, depressional, complex, 0 to 2 percent slopes, 1,900 feet east and 900 feet south of the northwest corner of sec. 28, T. 117 N., R. 32 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; cloddy; friable; neutral; clear smooth boundary.

A—10 to 17 inches; black (N 2/0) silty clay loam, dark gray (N 4/0) dry; weak fine angular blocky structure parting to moderate very fine angular blocky; friable; neutral; clear smooth boundary.

AB—17 to 27 inches; very dark gray (5Y 3/1) silty clay loam, dark gray (5Y 4/1) dry; weak fine angular blocky structure parting to strong very fine angular blocky; friable; neutral; clear wavy boundary.

Bg1—27 to 36 inches; olive gray (5Y 4/2) silty clay loam; weak fine prismatic structure parting to strong medium angular blocky; firm; neutral; clear wavy boundary.

Bg2—36 to 47 inches; olive gray (5Y 5/2) silty clay loam; moderate fine prismatic structure parting to strong medium angular blocky; firm; neutral; clear wavy boundary.

Bkg—47 to 60 inches; olive gray (5Y 5/2) silty clay loam; moderate fine prismatic structure parting to strong medium angular blocky; firm; common fine prominent light olive brown (2.5Y 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; slightly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 25 to 56 inches
Thickness of the mollic epipedon: 24 to 48 inches

Ap horizon:
Hue—10YR or neutral
Value—2
Chroma—0 or 1
Texture—silty clay loam

Bg horizon:
Hue—5Y
Value—3 to 5
Chroma—1 or 2
Texture—silty clay loam or silty clay

Bkg horizon:
Hue—5Y
Value—5 or 6
Chroma—1 or 2
Texture—silty clay loam or silt loam

134—Okoboji silty clay loam, depressional, 0 to 1 percent slopes

Composition

Okoboji and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Depressions on lake plains and moraines
Slope range: 0 to 1 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Very poorly drained
Dominant parent material: Lacustrine deposits over till
Flooding: None
Depth to the water table: 1 foot above to 1 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 11.6 inches (high)
Content of organic matter in the surface layer: About 8.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Harps and similar soils
- Canisteo and similar soils
- Klossner and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Omsrud Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 6 to 18 percent
Taxonomic classification: Fine-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Omsrud loam, in an area of Storden-Omsrud complex, 6 to 12 percent slopes, eroded, 550 feet east and 1,200 feet south of the northwest corner of sec. 24, T. 119 N., R. 32 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; 1 percent gravel; neutral; abrupt smooth boundary.

Bw1—9 to 15 inches; olive brown (2.5Y 4/4) loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; friable; 2 percent gravel; 2 percent cobbles and stones; neutral; clear smooth boundary.

Bw2—15 to 25 inches; light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; friable; few dark brown (10YR 4/3) organic stains on faces of peds; neutral; clear smooth boundary.

Bk—25 to 60 inches; light yellowish brown (2.5Y 6/4) loam; weak coarse subangular blocky structure parting to weak thin platy; friable; few fine distinct light olive brown (2.5Y 5/6) relict mottles; common fine irregular soft white (10YR 8/1) masses and threads of calcium carbonate; 3 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches
Thickness of the mollic epipedon: 7 to 16 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam
Content of rock fragments—1 to 2 percent gravel; 0 to 1 percent cobbles and stones

Bw horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—loam or clay loam
Content of rock fragments—1 to 4 percent gravel; 1 to 4 percent cobbles and stones

Bk horizon:
Hue—2.5Y
Value—5 or 6
Chroma—4
Texture—loam
Content of rock fragments—3 to 5 percent gravel; 3 to 5 percent cobbles and stones

1030—Pits, gravel-Udipsamments complex

Composition

Pits, gravel: 45 percent
Udipsamments: 45 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces
Slope range: Udipsamments—0 to 30 percent

Component Description

Pits, gravel

Dominant parent material: Glacial outwash

Udipsamments

Surface layer texture: Sand
Depth to bedrock: Greater than 60 inches
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.0 inches (low)

Inclusions

- Biscay and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Reedslake Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 2 to 5 percent
Taxonomic classification: Fine-loamy, mixed, mesic Typic Argiudolls

Typical Pedon

Reedslake loam, 2 to 5 percent slopes, 2,200 feet east and 1,500 feet north of the southwest corner of sec. 22, T. 118 N., R. 29 W.

A—0 to 12 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 1 percent gravel; neutral; abrupt smooth boundary.

Bt—12 to 26 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; friable; common very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores, few very dark brown (10YR 2/2) clay films in channels; about 2 percent gravel; neutral; clear smooth boundary.

Bk1—26 to 32 inches; light yellowish brown (2.5Y 6/4) loam; weak coarse subangular blocky structure parting to weak medium platy; friable; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate; about 2 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk2—32 to 48 inches; light yellowish brown (2.5Y 6/4) loam; weak coarse subangular blocky structure parting to weak medium platy; friable; few fine distinct light brownish gray (2.5Y 6/2) iron depletions; few fine prominent strong brown (7.5YR 5/8) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate; about 3 percent gravel; about 1 percent cobbles; strongly effervescent; moderately alkaline; clear smooth boundary.

C—48 to 60 inches; light yellowish brown (2.5Y 6/4) loam; massive; friable; common fine distinct light brownish gray (2.5Y 6/2) iron depletions; few fine prominent strong brown (7.5YR 5/8) iron concentrations; few masses and threads of calcium carbonate; about 3 percent gravel; about 1 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 48 inches
Thickness of the mollic epipedon: 9 to 16 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam
Content of rock fragments—1 to 2 percent gravel; 0 to 1 percent cobbles and stones

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—loam or clay loam
Content of rock fragments—1 to 3 percent gravel; 1 to 4 percent cobbles and stones

Bk horizon:
Hue—2.5Y
Value—5 or 6
Chroma—3 or 4
Texture—loam
Content of rock fragments—3 to 5 percent gravel; 1 to 3 percent cobbles and stones

1204B—Reedslake loam, 2 to 5 percent slopes

Composition

Reedslake and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 2 to 5 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 3.5 to 6.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.3 inches (high)
Content of organic matter in the surface layer: About 4 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cordova and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

- Forest Land section

Rohrbeck Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Rapid in the upper part, moderately rapid in the lower part
Landform: Moraines
Parent material: Glacial outwash over till
Slope range: 1 to 5 percent
Taxonomic classification: Loamy, mixed, mesic Arenic Hapludalfs

Typical Pedon

Rohrbeck loamy sand, in an area of Rohrbeck-Koronis complex, 1 to 6 percent slopes, 1,800 feet south and 2,000 feet east of the northwest corner of sec. 31, T. 121 N., R. 30 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loamy sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; 1 percent gravel; moderately acid; abrupt smooth boundary.

E1—6 to 12 inches; dark brown (10YR 4/3) loamy sand; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; many dark brown (10YR 3/3) organic coatings; about 5 percent gravel; slightly acid; clear smooth boundary.

E2—12 to 25 inches; dark yellowish brown (10YR 4/4) loamy sand; weak medium subangular blocky structure parting to weak fine subangular blocky; very friable; many dark brown (10YR 4/3) organic coatings; about 5 percent gravel; neutral; abrupt smooth boundary.

2Bt1—25 to 33 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure parting to weak fine subangular blocky; very friable; many dark brown (10YR 4/3) organic coatings; few dark brown (10YR 3/3) clay films on faces of peds and in pores; about 8 percent gravel; 3 percent cobbles and stones; neutral; clear smooth boundary.

2Bt2—33 to 41 inches; light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; few fine distinct grayish brown (2.5Y 5/2) iron depletions; many olive brown (2.5Y 4/4) organic coatings on faces of peds and in pores; few dark brown (10YR 4/3) clay films on faces of peds and in pores; about 5 percent gravel; about 5 percent cobbles; neutral; clear smooth boundary.

2Bk—41 to 60 inches; light yellowish brown (2.5Y 6/4) sandy loam; weak medium subangular blocky structure; friable; common fine prominent yellowish brown (10YR 5/6) iron concentrations and common distinct light brownish gray (2.5Y 6/2) iron depletions; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; about 7 percent gravel; about 5 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Thickness of the sandy mantle: 20 to 40 inches
Depth to carbonates: 30 to 50 inches

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—2 or 3
Texture—loamy sand
Content of rock fragments—0 to 2 percent gravel

E horizon:
Hue—10YR
Value—3 or 4
Chroma—2 to 4
Texture—sand, fine sand, loamy sand, or loamy fine sand
Content of rock fragments—0 to 5 percent gravel

2Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—sandy loam or fine sandy loam in the upper part; sandy loam, fine sandy loam, loam, or sandy clay loam in the lower part
Content of rock fragments—4 to 8 percent gravel; 4 to 5 percent cobbles and stones

2Bk horizon:
Hue—2.5Y
Value—5 or 6
Chroma—3 or 4
Texture—sandy loam or fine sandy loam
Content of rock fragments—6 to 9 percent gravel; 4 to 6 percent cobbles and stones

1198B—Rohrbeck-Koronis complex, 1 to 6 percent slopes

Composition

Rohrbeck and similar soils: About 55 percent
Koronis and similar soils: About 35 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: Rohrbeck—1 to 5 percent; Koronis—3 to 6 percent

Component Description

Rohrbeck

Surface layer texture: Loamy sand
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Glacial outwash over till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.1 inches (moderate)
Content of organic matter in the surface layer: About 1.25 percent (moderately low)

Koronis

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.9 inches (moderate)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Barry and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Rolfe Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Slow
Landform: Moraines
Parent material: Till
Slope range: 0 to 1 percent
Taxonomic classification: Fine, montmorillonitic, mesic Typic Argialbolls

Typical Pedon

Rolfe silt loam, in an area of Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes, 1,800 feet north and 500 feet east of the southwest corner of sec. 1, T. 118 N., R. 29 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; cloddy; friable; slightly acid; abrupt smooth boundary.
AE—9 to 16 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine angular blocky structure; friable; slightly acid; clear smooth boundary.
E—16 to 23 inches; very dark gray (10YR 3/1) silt loam, light gray (10YR 6/1) dry; weak very thin platy structure; very friable; moderately acid; clear smooth boundary.
EB—23 to 28 inches; very dark gray (10YR 3/1) silt loam, light gray (10YR 6/1) dry; weak thin platy structure parting to weak fine angular blocky; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; very many black (10YR 2/1) organic coatings on faces of peds and in pores; 1 percent gravel; moderately acid; clear smooth boundary.
Btg1—28 to 40 inches; olive gray (5Y 4/2) silty clay; moderate coarse prismatic structure parting to moderate very coarse angular blocky; firm; common black (N 2/0) clay films on faces of peds; very many black (10YR 2/1) organic coatings on faces of peds and in pores; 1 percent gravel; 3 percent cobbles and stones; neutral; clear smooth boundary.
2Btg2—40 to 52 inches; olive gray (5Y 4/2) clay loam; moderate coarse prismatic structure parting to moderate very coarse angular blocky; firm; common very dark gray (N 3/0) clay films on faces of peds; very many very dark gray (N 3/0) organic coatings on faces of peds and in pores; 2 percent gravel; 3 percent cobbles and stones; neutral; clear smooth boundary.
2Btg3—52 to 60 inches; light olive gray (5Y 6/2) clay loam; weak medium angular blocky structure;

friable; many medium prominent light olive brown (2.5Y 5/6) iron concentrations; common very dark gray (5Y 3/1) clay films on faces of peds; 2 percent gravel; 3 percent cobbles and stones; neutral.

Range in Characteristics

Depth to carbonates: 42 to 60 inches
Thickness of the mollic epipedon: 10 to 24 inches
Other features: A C horizon in some pedons

Ap horizon:
Hue—10YR
Value—2
Chroma—1
Texture—silt loam
Content of rock fragments—0 to 5 percent gravel

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—silt loam or loam
Content of rock fragments—0 to 5 percent gravel

E horizon:
Hue—10YR
Value—3 or 4
Chroma—1
Texture—loam or silt loam
Content of rock fragments—0 to 5 percent gravel

Btg horizon:
Hue—5Y
Value—4 to 6
Chroma—2
Texture—silty clay or clay loam
Content of rock fragments—2 to 4 percent gravel; 2 to 4 percent cobbles and stones

Seaforth Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 1 to 3 percent
Taxonomic classification: Fine-loamy, mixed, mesic Aquic Calciudolls

Typical Pedon

Seaforth loam, 1 to 3 percent slopes, 580 feet north and 1,550 feet west of the southeast corner of sec. 22, T. 117 N., R. 31 W.

Ap—0 to 12 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; cloddy; friable; 1 percent gravel; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—12 to 28 inches; grayish brown (2.5Y 5/2) loam; weak very fine subangular blocky structure; friable; 2 percent gravel; 2 percent cobbles and stones; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; violently effervescent; slightly alkaline; clear smooth boundary.

Bk2—28 to 36 inches; light olive brown (2.5Y 5/4) loam; weak coarse subangular blocky structure; friable; few medium distinct grayish brown (2.5Y 5/2) iron depletions; many fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; few strong brown (7.5YR 5/8) iron concentrations in ped interiors; 3 percent gravel; 3 percent cobbles and stones; violently effervescent; slightly alkaline; clear smooth boundary.

Bk3—36 to 60 inches; light olive brown (2.5Y 5/4) loam; weak coarse subangular blocky structure; friable; many medium distinct grayish brown (2.5Y 5/2) iron depletions; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; few strong brown (7.5YR 5/8) iron oxide concentrations in ped interiors; 3 percent gravel; 3 percent cobbles and stones; violently effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 7 inches
Thickness of the mollic epipedon: 10 to 20 inches

Ap horizon:
Hue—10YR
Value—2 or 3
Chroma—1
Texture—loam
Content of rock fragments—0 to 5 percent gravel; 0 to 1 percent cobbles and stones

Bk horizon:
Hue—2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—loam or clay loam
Content of rock fragments—2 to 4 percent gravel; 1 to 4 percent cobbles and stones

423—Seaforth loam, 1 to 3 percent slopes

Composition

Seaforth and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Rises on moraines
Slope range: 1 to 3 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.9 inches (high)
Content of organic matter in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Canisteo and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Shorewood Series

Depth class: Very deep
Drainage class: Moderately well drained and somewhat poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Lacustrine deposits
Slope range: 0 to 12 percent
Taxonomic classification: Fine, montmorillonitic, mesic Aquertic Argiudolls

Typical Pedon

Shorewood silty clay loam, 3 to 6 percent slopes, 2,110 feet south and 1,000 feet east of the northwest corner of sec. 10, T. 120 N., R. 30 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; strong very fine angular blocky structure; firm; common light gray or gray (10YR 6/1) silt coatings on faces of peds; neutral; abrupt smooth boundary.

A—8 to 12 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; strong fine angular blocky structure parting to strong very fine angular blocky; firm; neutral; clear smooth boundary.

Bt1—12 to 19 inches; olive brown (2.5Y 4/3) silty clay; weak fine prismatic structure parting to strong very fine angular blocky; firm; common very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; slightly acid; clear smooth boundary.

Bt2—19 to 27 inches; light olive brown (2.5Y 5/3) silty clay; weak medium prismatic structure parting to strong very fine angular blocky; firm; few fine prominent yellowish brown (10YR 5/6) iron concentrations; common very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; few black (10YR 2/1) clay films in channels; moderately acid; clear smooth boundary.

Bt3—27 to 38 inches; light olive brown (2.5Y 5/3) silty clay; weak medium prismatic structure parting to moderate very fine angular blocky; friable; few fine prominent yellowish brown (10YR 5/6) iron concentrations; common very dark grayish brown (10YR 3/2) clay films on faces of peds and in pores; few black (10YR 2/1) clay films in channels; moderately acid; clear smooth boundary.

Bk1—38 to 45 inches; light yellowish brown (2.5Y 6/4) silty clay loam; strong thin platy structure; friable; common fine faint light olive brown (2.5Y 5/4) iron concentrations; common fine irregular soft white (10YR 8/2) threads and masses of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—45 to 60 inches; stratified light yellowish brown (2.5Y 6/4), friable silty clay loam and grayish brown (2.5Y 5.2), firm silty clay; common fine faint light olive brown (2.5Y 5/4) iron concentrations; strong thin platy structure; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 28 to 50 inches
Thickness of the mollic epipedon: 10 to 18 inches

A horizon:
  Hue—10YR
  Value—2 or 3
  Chroma—1 or 2
  Texture—silty clay or silty clay loam

Bt horizon:
  Hue—2.5Y
  Value—4 or 5
  Chroma—2
  Texture—silty clay

Bk horizon:
  Hue—2.5Y
  Value—5 or 6
  Chroma—2 to 4
  Texture—stratified silty clay loam and silty clay (silty strata 2 to 4 inches thick; clayey strata 1/2 inch to 2 inches thick)

286B—Shorewood silty clay loam, 3 to 6 percent slopes

Composition

Shorewood and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Rises on lake plains
Slope range: 3 to 6 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.5 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Waldorf and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

311C2—Shorewood silty clay, 6 to 12 percent slopes, eroded

Composition

Shorewood and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Lake plains
Position on the landform: Summits and backslopes
Slope range: 6 to 12 percent

Component Description

Surface layer texture: Silty clay
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.0 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Bold and similar soils
- Waldorf and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

1383A—Shorewood silty clay loam, moderately wet, 0 to 3 percent slopes

Composition

Shorewood and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Slight rises on lake plains
Slope range: 0 to 3 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Somewhat poorly drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: 1.5 to 2.5 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.3 inches (high)
Content of organic matter in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Waldorf and similar soils
- Rolfe and similar soils

Major Uses of the Unit

- Cropland
- Pasture
- Forest land

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section
- Forest Land section

Sparta Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Rapid
Landform: Outwash plains and terraces
Parent material: Glacial outwash
Slope range: 1 to 25 percent
Taxonomic classification: Sandy, mixed, mesic Entic Hapludolls

Typical Pedon

Sparta loamy sand, 1 to 6 percent slopes, 700 feet west and 2,050 feet north of the southeast corner of sec. 26, T. 121 N., R. 31 W.

Ap—0 to 11 inches; very dark brown (10YR 2/2) loamy sand, dark gray (10YR 4/1) dry; weak very fine granular structure; very friable; slightly acid; clear smooth boundary.
A—11 to 16 inches; very dark brown (10YR 2/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; moderately acid; clear smooth boundary.
Bw1—16 to 21 inches; dark brown (10YR 4/3) loamy sand; weak fine subangular blocky structure; very friable; moderately acid; clear smooth boundary.
Bw2—21 to 29 inches; brown (10YR 5/3) loamy sand; weak fine subangular blocky structure; very friable; moderately acid; gradual smooth boundary.
C1—29 to 44 inches; brown (10YR 5/3) fine sand; single grain; loose; slightly acid; gradual smooth boundary.
C2—44 to 60 inches; brown (10YR 5/3) sand; single grain; loose; neutral.

Range in Characteristics

Depth to carbonates: 40 to more than 60 inches
Thickness of the mollic epipedon: 10 to 24 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loamy fine sand or loamy sand
Content of rock fragments—0 to 5 percent gravel

Bw horizon:
Hue—10YR
Value—3 to 5
Chroma—3 or 4
Texture—loamy fine sand, loamy sand, sand, or fine sand
Content of rock fragments—0 to 5 percent gravel

C horizon:
Hue—10YR
Value—4 to 6
Chroma—3 to 6

Texture—sand or fine sand
Content of rock fragments—0 to 10 percent gravel

8B—Sparta loamy sand, 1 to 6 percent slopes

Composition

Sparta and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces
Slope range: 1 to 6 percent

Component Description

Surface layer texture: Loamy sand
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.4 inches (low)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils
- Dassel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

8C—Sparta loamy sand, 6 to 12 percent slopes

Composition

Sparta and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Summits and backslopes
Slope range: 6 to 12 percent

Component Description

Surface layer texture: Loamy sand
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 3.8 inches (low)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

8D—Sparta loamy sand, 12 to 25 percent slopes

Composition

Sparta and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains and terraces
Position on the landform: Backslopes
Slope range: 12 to 25 percent

Component Description

Surface layer texture: Loamy sand
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash

Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.5 inches (low)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1172C—Sparta-Gardencity complex, 6 to 12 percent slopes

Composition

Sparta and similar soils: About 70 percent
Gardencity and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Outwash plains
Position on the landform: Summits and backslopes
Slope range: 6 to 12 percent

Component Description

Sparta

Surface layer texture: Loamy sand
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 5.1 inches (low)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

Gardencity

Surface layer texture: Fine sandy loam
Depth to bedrock: Greater than 80 inches
Drainage class: Well drained
Dominant parent material: Glaciolacustrine deposits or glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 8.5 inches (moderate)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Darfur and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Spicer Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Lake plains
Parent material: Lacustrine deposits
Slope range: 0 to 2 percent
Taxonomic classification: Fine-silty, mixed (calcareous), mesic Typic Endoaquolls

Typical Pedon

Spicer silty clay loam, 0 to 2 percent slopes, 2,100 feet south and 1,000 feet west of the northeast corner of sec. 36, T. 120 N., R. 30 W.

Ap—0 to 7 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; very friable; strongly effervescent; slightly alkaline; clear smooth boundary.
A—7 to 14 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; moderate fine subangular blocky structure; very friable; strongly effervescent; slightly alkaline; abrupt smooth boundary.
Bkg1—14 to 20 inches; dark gray (5Y 4/1) silty clay loam; weak fine subangular blocky structure

parting to moderate very fine subangular blocky; very friable; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; violently effervescent; moderately alkaline; clear smooth boundary.

Bkg2—20 to 27 inches; olive gray (5Y 5/2) silt loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; common fine prominent olive (5Y 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline; clear smooth boundary.

Bkg3—27 to 60 inches; light olive gray (5Y 6/2) silt loam; moderate very thin platy structure; very friable; many fine prominent light olive brown (2.5Y 5/6) iron concentrations; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface
Thickness of the mollic epipedon: 12 to 24 inches

A horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam

Bkg horizon (upper part):
Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay loam or silt loam

Bkg horizon (lower part):
Hue—5Y
Value—5 or 6
Chroma—1 or 2
Texture—silt loam or silty clay loam

140—Spicer silty clay loam, 0 to 2 percent slopes

Composition

Spicer and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Rims of depressions and flats on lake plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 11.7 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Madelia and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Storden Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 4 to 40 percent
Taxonomic classification: Fine-loamy, mixed, mesic Typic Eutrochrepts

Typical Pedon

Storden loam (fig. 17), in an area of Storden-Omsrud complex, 6 to 12 percent slopes, eroded, 2,400 feet north and 2,300 feet west of the southeast corner of sec. 22, T. 117 N., R. 31 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; weak fine subangular blocky structure; friable; 2 percent gravel; 2 percent cobbles and stones; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—8 to 21 inches; light olive brown (2.5Y 5/4) loam; weak medium platy structure; friable; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; few red (2.5YR 4/6) streaks; 2 percent gravel; 3 percent cobbles and stones; violently effervescent; slightly alkaline; clear smooth boundary.

Bk2—21 to 60 inches; light olive brown (2.5Y 5/4) loam; weak medium platy structure; friable; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; few red (2.5YR 4/6) iron oxide concentrations; 3 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface
Content of rock fragments: 2 to 5 percent gravel; 2 to 5 percent cobbles and stones

A horizon:
Hue—10YR
Value—4 or 5
Chroma—2 or 3
Texture—loam

Bk horizon:
Hue—2.5Y
Value—5 or 6
Chroma—2 to 6
Texture—loam

960C2—Storden-Omsrud complex, 6 to 12 percent slopes, eroded

Composition

Storden and similar soils: About 65 percent
Omsrud and similar soils: About 25 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Storden—shoulders and summits; Omsrud—summits and backslopes
Slope range: 6 to 12 percent

Component Description

Storden

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

Omsrud

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.1 inches (high)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hamel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

960D2—Storden-Omsrud complex, 12 to 18 percent slopes, eroded

Composition

Storden and similar soils: About 65 percent
Omsrud and similar soils: About 25 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Storden—backslopes and shoulders; Omsrud—backslopes
Slope range: 12 to 18 percent

Component Description

Storden

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter in the surface layer: About 1.5 percent (moderately low)

Omsrud

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.0 inches (high)
Content of organic matter in the surface layer: About 3 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Hamel and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Strout Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Moraines
Parent material: Till
Slope range: 2 to 18 percent
Taxonomic classification: Fine, montmorillonitic, mesic Vertic Hapludolls

Typical Pedon

Strout clay, in an area of Strout-Arkton complex, 2 to 6 percent slopes, 300 feet west and 300 feet north of the southeast corner of sec. 14, T. 118 N., R. 32 W.

Ap—0 to 7 inches; clay, black (10YR 2/1) dry; weak fine subangular blocky structure; friable; about 2 percent gravel; neutral; abrupt smooth boundary.

AB—7 to 10 inches; black (10YR 2/1) clay, dark gray (10YR 4/1) dry; about 20 percent masses of dark olive brown (2.5Y 4/4) clay, light yellowish brown (2.5Y 6/4) dry; moderate fine angular blocky structure parting to moderate very fine angular blocky; friable; 2 percent gravel; 1 percent cobbles; neutral; clear smooth boundary.

Bt1—10 to 16 inches; clay, olive brown (2.5Y 4/4) dry; moderate fine angular blocky structure parting to moderate very fine angular blocky; firm; dark grayish brown (2.5Y 4/2) clay films on faces of peds; 2 percent gravel; 1 percent cobbles; neutral; clear smooth boundary.

Bt2—16 to 24 inches; olive brown (2.5Y 4/4) clay; moderate fine prismatic structure parting to moderate very fine angular blocky; firm; dark grayish brown (2.5Y 4/2) clay films on faces of peds; 3 percent gravel; 1 percent cobbles; neutral; clear smooth boundary.

Bk1—24 to 36 inches; light olive brown (2.5Y 5/4) clay loam; weak coarse angular blocky structure parting to weak fine angular blocky; firm; few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 2 percent cobbles; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—36 to 60 inches; light olive brown (2.5Y 5/4) clay loam; weak coarse angular blocky structure parting to weak fine angular blocky; firm; few fine distinct light brownish gray (2.5Y 6/2) iron depletions; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 3 percent gravel; 2 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 36 inches
Thickness of the mollic epipedon: 7 to 24 inches

A horizon:
  Hue—10YR
  Value—2 or 3
  Chroma—1 or 2
  Texture—clay or clay loam
  Content of rock fragments—1 to 2 percent gravel; 0 to 1 percent cobbles and stones

Bt horizon:
  Hue—2.5Y
  Value—4 or 5

Chroma—3 or 4
Texture—clay loam, clay, silty clay, or silty clay loam
Content of rock fragments—1 to 3 percent gravel; 0 to 2 percent cobbles and stones

Bk horizon:
Hue—2.5Y
Value—5 or 6
Chroma—2 to 4
Texture—clay loam, clay, silty clay, or silty clay loam
Content of rock fragments—1 to 4 percent gravel; 0 to 1 percent cobbles and stones

1159B—Strout-Arkton complex, 2 to 6 percent slopes

Composition

Strout and similar soils: About 70 percent
Arkton and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Strout—summits and backslopes; Arkton—shoulders and summits
Slope range: Strout—2 to 6 percent; Arkton—4 to 6 percent

Component Description

Strout

Surface layer texture: Clay
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 8.3 inches (moderate)
Content of organic matter in the surface layer: About 4.5 percent (high)

Arkton

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Moderately well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 2.5 to 4.0 feet
Kind of water table: Perched
Available water capacity to 60 inches or root-limiting layer: About 9.5 inches (high)
Content of organic matter in the surface layer: About 3.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Cosmos and similar soils
- Lura and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Sunburg Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Moraines
Parent material: Till
Slope range: 4 to 40 percent
Taxonomic classification: Coarse-loamy, mixed (calcareous), mesic Typic Udorthents

Typical Pedon

Sunburg sandy loam, in an area of Sunburg-Wadenill complex, 6 to 12 percent slopes, eroded, 1,400 feet west and 500 feet north of the southeast corner of sec. 9, T. 121 N., R. 32 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) sandy loam; weak fine subangular blocky structure; very friable; 6 percent gravel; 4 percent cobbles and stones; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—8 to 14 inches; light yellowish brown (2.5Y 6/4) sandy loam; weak coarse subangular blocky structure parting to weak medium platy; very friable; common fine distinct light olive brown (2.5Y 5/6) relict iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 7 percent gravel; 5 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—14 to 60 inches; light yellowish brown (2.5Y 6/4) sandy loam; weak coarse subangular blocky structure parting to weak thick platy; very friable; few distinct light olive brown (2.5Y 5/6) relict iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 8 percent gravel; 6 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface
Content of rock fragments: 6 to 10 percent gravel; 3 to 5 percent cobbles and stones

A horizon:
Hue—10YR
Value—3 or 4
Chroma—2 or 3
Texture—sandy loam or fine sandy loam

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6
Chroma—3 or 4
Texture—loam, sandy loam, or fine sandy loam (average clay content of less than 18 percent)

805C2—Sunburg-Wadenill complex, 6 to 12 percent slopes, eroded

Composition

Sunburg and similar soils: About 50 percent
Wadenill and similar soils: About 40 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Sunburg—shoulders and summits; Wadenill—summits and backslopes
Slope range: 6 to 12 percent

Component Description

Sunburg

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.2 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Wadenill

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.5 inches (high)
Content of organic matter in the surface layer: About 3.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Forestcity and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

805D2—Sunburg-Wadenill complex, 12 to 18 percent slopes, eroded

Composition

Sunburg and similar soils: About 65 percent
Wadenill and similar soils: About 25 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Sunburg—backslopes and shoulders; Wadenill—backslopes
Slope range: 12 to 18 percent

Component Description

Sunburg

Surface layer texture: Sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet

Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

Wadenill

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.5 inches (high)
Content of organic matter in the surface layer: About 3.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Forestcity and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Swanlake Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Moraines
Parent material: Till
Slope range: 4 to 6 percent
Taxonomic classification: Fine-loamy, mixed, mesic Typic Calciudolls

Typical Pedon

Swanlake loam, in an area of Clarion-Swanlake complex, 2 to 6 percent slopes, 2,000 feet west and 1,600 feet north of the southeast corner of sec. 24, T. 119 N., R. 32 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam; weak fine subangular blocky structure; friable; few dark yellowish brown (10YR 4/4) streaks in ped interiors; 1 percent gravel; 1 percent cobbles and stones; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Bk1—8 to 12 inches; dark brown (10YR 4/3) loam; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; 2 percent gravel; 2 percent cobbles and stones; slightly effervescent; slightly alkaline; clear smooth boundary.

Bk2—12 to 21 inches; light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; common fine distinct light brownish gray (2.5Y 6/2) relict iron depletions and few fine distinct light olive brown (2.5Y 5/6) relict iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 2 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk3—21 to 60 inches; light olive brown (2.5Y 5/4) loam; weak coarse subangular blocky structure parting to weak fine subangular blocky; friable; common fine distinct light olive brown (2.5Y 5/6) relict iron concentrations; fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; few soft strong brown (7.5YR 5/8) accumulations; 3 percent gravel; 3 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Thickness of the mollic epipedon: 7 to 11 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam
Content of rock fragments—1 to 2 percent gravel; 0 to 1 percent cobbles and stones

Bk horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—loam
Content of rock fragments—3 to 5 percent gravel; 3 to 5 percent cobbles and stones

Swedegrove Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately rapid
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Coarse-loamy, mixed (calcareous), mesic Typic Endoaquolls

Typical Pedon

Swedegrove loam, 0 to 2 percent slopes, 2,300 feet east and 500 feet south of the northwest corner of sec. 17, T. 120 N., R. 31 W.

Ap—0 to 9 inches; black (N 2/0) loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; very friable; 2 percent gravel; 1 percent cobbles; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Ak—9 to 14 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; few fine irregular soft light brownish gray (2.5Y 6/2) threads and masses of calcium carbonate distributed uniformly throughout the horizon; about 2 percent gravel; about 1 percent cobbles; violently effervescent; slightly alkaline; clear smooth boundary.

Bkg1—14 to 20 inches; olive gray (5Y 5/2) fine sandy loam; weak fine subangular blocky structure parting to weak very fine subangular blocky; very friable; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; about 2 percent gravel; about 2 percent cobbles; violently effervescent; slightly alkaline; clear smooth boundary.

Bkg2—20 to 60 inches; light yellowish brown (2.5Y 6/4) fine sandy loam; weak coarse subangular blocky structure; very friable; many medium distinct light olive gray (5Y 6/2) iron depletions; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 6 percent gravel; 6 percent cobbles; strongly effervescent; slightly alkaline.

Range in Characteristics

Carbonates: At the surface
Thickness of the mollic epipedon: 12 to 24 inches

Ap horizon:
Hue—10YR or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loam
Content of rock fragments—1 to 3 percent gravel; 1 to 3 percent cobbles and stones

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—2 or 3
Chroma—0 or 1
Texture—loam or sandy clay loam
Content of rock fragments—1 to 3 percent gravel; 1 to 3 percent cobbles and stones

Bkg horizon (upper part):
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam, sandy clay loam, fine sandy loam, or sandy loam
Content of rock fragments—2 to 6 percent gravel; 2 to 4 percent cobbles and stones

Bkg horizon (lower part):
Hue—5Y or 2.5Y
Value—4 to 6
Chroma—2 to 4
Texture—fine sandy loam or sandy loam
Content of rock fragments—4 to 8 percent gravel; 4 to 7 percent cobbles and stones

1168—Swedegrove-Lundlake, depressional, complex, 0 to 2 percent slopes

Composition

Swedegrove and similar soils: About 70 percent
Lundlake and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Swedegrove—rims of depressions and flats; Lundlake—depressions
Slope range: Swedegrove—0 to 2 percent; Lundlake—0 to 1 percent

Component Description

Swedegrove

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches

Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.9 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

Lundlake

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 80 inches
Drainage class: Very poorly drained
Dominant parent material: Till
Flooding: None
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Kind of water table: Apparent
Ponding duration: Very long
Available water capacity to 60 inches or root-limiting layer: About 9.8 inches (high)
Content of organic matter in the surface layer: About 8.5 percent (very high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Grovecity and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1175—Swedegrove loam, 0 to 2 percent slopes

Composition

Swedegrove and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Rims of depressions and flats on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 8.5 inches (moderate)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Truman Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Lacustrine deposits
Slope range: 2 to 18 percent
Taxonomic classification: Fine-silty, mixed, mesic Typic Hapludolls

Typical Pedon

Truman silt loam, 2 to 6 percent slopes, 500 feet south and 200 feet east of the northwest corner of sec. 28, T. 120 N., R. 30 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.
AB—9 to 14 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium subangular blocky structure; very friable; slightly acid; clear smooth boundary.

Bw1—14 to 20 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.
Bw2—20 to 31 inches; yellowish brown (10YR 5/4) silt loam; weak coarse subangular blocky structure parting to weak very fine subangular blocky; friable; neutral; clear smooth boundary.
Bk1—31 to 40 inches; light olive brown (2.5Y 5/4) silt loam; weak thin platy structure; friable; very few fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline; clear smooth boundary.
Bk2—40 to 60 inches; light olive brown (2.5Y 5/4) silt loam; moderate thin platy structure; friable; common fine distinct light olive brown (2.5Y 5/6) and common prominent yellowish brown (10YR 5/8) relict iron concentrations; few white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 36 inches
Thickness of the mollic epipedon: 10 to 18 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—silt loam

Bw horizon:
Hue—10YR
Value—3 to 5
Chroma—3 to 5
Texture—silt loam or silty clay loam

Bk horizon:
Hue—2.5Y or 10YR
Value—5 or 6
Chroma—4 to 6
Texture—silt loam

101B—Truman silt loam, 2 to 6 percent slopes

Composition

Truman and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Lake plains
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Surface layer texture: Silt loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 11.9 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Madelia and similar soils
- Okoboji and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1015—Udipsamments (cut and fill land)

Composition

Udipsamments and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Outwash plains and terraces
Slope range: 0 to 6 percent

Component Description

Surface layer texture: Sand
Depth to bedrock: Greater than 60 inches
Drainage class: Excessively drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 4.0 inches (low)

Inclusions

- Biscay and similar soils
- Darfur and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1016—Udorthents, loamy (cut and fill land)

Composition

Udorthents: Variable
Inclusions: About 15 percent

Setting

Landform: Moraines
Slope range: 0 to 20 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 6.6 inches (moderate)
Content of organic matter in the surface layer: About 0.75 percent (low)

Inclusions

- Webster and similar soils
- Glencoe and similar soils

Major Uses of the Unit

- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Uniongrove Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately rapid
Landform: Moraines
Parent material: Till
Slope range: 0 to 2 percent
Taxonomic classification: Coarse-loamy, mixed, mesic Typic Endoaquolls

Typical Pedon

Uniongrove loam, 0 to 2 percent slopes, 1,500 feet east and 1,525 feet south of the northwest corner of sec. 27, T. 121 N., R. 32 W.

Ap—0 to 9 inches; black (N 2/0) loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; friable; about 1 percent gravel; 1 percent cobbles; slightly acid; abrupt smooth boundary.

A—9 to 16 inches; very dark gray (10YR 3/1) loam, dark gray (N 4/0) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; about 1 percent gravel; 1 percent cobbles; neutral; clear smooth boundary.

Bg1—16 to 24 inches; olive gray (5Y 4/2) loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; friable; few fine prominent light olive brown (2.5Y 5/6) iron concentrations; very dark gray (10YR 3/1) organic coatings on faces of peds; 3 percent gravel; 1 percent cobbles; neutral; clear smooth boundary.

Bg2—24 to 30 inches; olive gray (5Y 5/2) fine sandy loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; common fine prominent light olive brown (2.5Y 5/6) iron concentrations; 3 percent gravel; 2 percent cobbles; neutral; clear smooth boundary.

Bkg1—30 to 38 inches; olive gray (5Y 5/2) fine sandy loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; common fine prominent light olive brown (2.5Y 5/6) iron concentrations and few distinct light brownish gray (2.5Y 6/2) iron depletions; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 5 percent gravel; 3 percent cobbles; violently effervescent; slightly alkaline; clear smooth boundary.

Bkg2—38 to 60 inches; light olive gray (5Y 6/2) fine sandy loam; weak coarse subangular blocky structure; very friable; common fine prominent light olive brown (2.5Y 5/6) and few light brownish gray (2.5Y 6/2) iron depletions; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 7 percent gravel; 4 percent cobbles; violently effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 16 to 42 inches
Thickness of the mollic epipedon: 11 to 24 inches

A horizon:
Hue—10YR, 2.5Y, or neutral
Value—2 or 3

Chroma—0 to 2
Texture—loam
Content of rock fragments—1 to 3 percent gravel; 1 to 3 percent cobbles and stones

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—loam, sandy clay loam, fine sandy loam, or sandy loam
Content of rock fragments—2 to 5 percent gravel; 1 to 4 percent cobbles and stones

Bkg horizon:
Hue—5Y
Value—5 or 6
Chroma—2 to 4
Texture—fine sandy loam, sandy loam, or loam that has a high content of sand
Content of rock fragments—4 to 8 percent gravel; 4 to 7 percent cobbles and stones

1178—Uniongrove loam, 0 to 2 percent slopes

Composition

Uniongrove and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.5 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lundlake and similar soils
- Swedegrove and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Wadena Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate in the loamy mantle and very rapid in the underlying sand and gravel
Landform: Outwash plains and terraces
Parent material: Glacial outwash
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls

Typical Pedon

Wadena loam, 0 to 2 percent slopes, 600 feet west and 400 feet north of the southeast corner of sec. 20, T. 119 N., R. 30 W.

Ap—0 to 9 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

A—9 to 13 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

Bw1—13 to 16 inches; dark brown (10YR 3/3) loam; weak very fine subangular blocky structure; friable; common very dark grayish brown (10YR 3/2) organic coatings on faces of peds and in pores; slightly acid; clear smooth boundary.

Bw2—16 to 29 inches; dark brown (10YR 4/4) loam; weak fine subangular blocky structure; friable; brown (10YR 4/3) organic coatings on faces of peds and in pores; neutral; clear smooth boundary.

2Bw3—29 to 35 inches; dark brown (7.5YR 4/4) gravelly loamy sand; weak fine subangular blocky structure; very friable; 20 percent gravel; neutral; clear smooth boundary.

2Bk—35 to 60 inches; yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; common soft white (10YR 8/1) and light gray (10YR 7/2) lime concentrations on the underside of gravel and very coarse sand; 20 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 30 to 50 inches
Thickness of the loamy mantle: 24 to 40 inches
Thickness of the mollic epipedon: 12 to 24 inches

A horizon:
Hue—10YR
Value—2
Chroma—1 or 2
Texture—loam
Content of rock fragments—0 to 2 percent gravel

Bw horizon:
Hue—10YR
Value—4 or 5
Chroma—3 or 4
Texture—loam; sandy loam or coarse sandy loam in the lower part in some pedons
Content of rock fragments—0 to 5 percent gravel

2Bk horizon:
Hue—10YR
Value—4 to 6
Chroma—2 to 4
Texture—stratified sand, coarse sand, or the gravelly or very gravelly analogs of these textures
Content of rock fragments—0 to 50 percent gravel

39A—Wadena loam, 0 to 2 percent slopes

Composition

Wadena and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on outwash plains and terraces
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Glacial outwash
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 6.3 inches (moderate)
Content of organic matter in the surface layer: About 4.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Biscay and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Wadenill Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Moraines
Parent material: Till
Slope range: 2 to 18 percent
Taxonomic classification: Coarse-loamy, mixed, mesic Typic Hapludolls

Typical Pedon

Wadenill loam, in an area of Wadenill-Sunburg complex, 2 to 6 percent slopes, 1,200 feet south and 1,500 feet east of the northwest corner of sec. 26, T. 120 N., R. 31 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; 2 percent gravel; 2 percent cobbles and stones; neutral; abrupt smooth boundary.

Bw1—9 to 16 inches; yellowish brown (10YR 5/4) loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; friable; very many dark brown (10YR 4/3) organic coatings on faces of peds and in pores; 4 percent gravel; 3 percent cobbles and stones; neutral; clear smooth boundary.

Bw2—16 to 25 inches; yellowish brown (10YR 5/4) fine sandy loam; weak medium subangular blocky structure parting to weak very fine subangular blocky; very friable; very many dark yellowish brown (10YR 4/4) organic coatings on faces of peds and in pores; 7 percent gravel; 4 percent cobbles and stones; neutral; clear smooth boundary.

Bk1—25 to 38 inches; light olive brown (2.5Y 5/4) fine sandy loam; weak medium subangular blocky structure; very friable; common fine distinct light brownish gray (2.5Y 6/2) relict iron depletions and few distinct yellowish brown (10YR 5/6) relict iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 8 percent gravel; 6 percent cobbles and stones; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—38 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam; weak medium subangular blocky structure; very friable; many medium distinct light brownish gray (2.5Y 6/2) relict iron depletions and common distinct yellowish brown (10YR 5/6) relict iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; 8 percent gravel; 6 percent cobbles and stones; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 18 to 40 inches
Thickness of the mollic epipedon: 7 to 16 inches

A horizon:
Hue—10YR
Value—2 or 3
Chroma—1 or 2
Texture—loam or sandy loam
Content of rock fragments—2 to 4 percent gravel; 1 to 3 percent cobbles and stones

Bw horizon:
Hue—10YR
Value—4 or 5
Chroma—3 or 4
Texture—loam, fine sandy loam, or sandy loam
Content of rock fragments—4 to 8 percent gravel; 3 to 5 percent cobbles and stones

Bk horizon:
Hue—10YR or 2.5Y
Value—4 or 5
Chroma—3 or 4
Texture—loam, sandy loam, or fine sandy loam
Content of rock fragments—6 to 10 percent gravel; 4 to 6 percent cobbles and stones

612B—Wadenill loam, 2 to 6 percent slopes

Composition

Wadenill and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Moraines
Position on the landform: Summits and backslopes
Slope range: 2 to 6 percent

Component Description

Surface layer texture: Loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.9 inches (high)
Content of organic matter in the surface layer: About 3.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Uniongrove and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1391B—Wadenill-Sunburg complex, 2 to 6 percent slopes

Composition

Wadenill and similar soils: About 70 percent
Sunburg and similar soils: About 20 percent
Inclusions: About 10 percent

Setting

Landform: Moraines
Position on the landform: Wadenill—summits and backslopes; Sunburg—shoulders and summits
Slope range: Wadenill—2 to 6 percent; Sunburg—4 to 6 percent

Component Description

Wadenill

Surface layer texture: Loam

Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.6 inches (high)
Content of organic matter in the surface layer: About 3.5 percent (moderate)

Sunburg

Surface layer texture: Fine sandy loam
Depth to bedrock: Greater than 60 inches
Drainage class: Well drained
Dominant parent material: Till
Flooding: None
Depth to the water table: Greater than 6.0 feet
Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)
Content of organic matter in the surface layer: About 2.5 percent (moderate)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Uniongrove and similar soils
- Lundlake and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Waldorf Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Lacustrine deposits
Slope range: 0 to 2 percent
Taxonomic classification: Fine, montmorillonitic, mesic Vertic Epiaquolls

Typical Pedon

Waldorf silty clay loam, 0 to 2 percent slopes, 1,200 feet north and 1,500 feet west of the southeast corner of sec. 24, T. 120 N., R. 30 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; cloddy; friable; neutral; clear smooth boundary.
A—8 to 13 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; moderate fine angular blocky structure parting to strong very fine angular blocky; firm; neutral; clear smooth boundary.
AB—13 to 23 inches; very dark gray (N 3/0) silty clay, dark gray (N 4/0) dry; strong fine angular blocky structure parting to strong very fine angular blocky; firm; many black (N 2/0) stress surfaces on faces of peds; neutral; clear smooth boundary.
Bg1—23 to 30 inches; olive gray (5Y 4/2) silty clay; strong fine prismatic structure parting to strong very fine angular blocky; firm; few fine prominent light olive brown (2.5Y 5/4) iron concentrations; many very dark gray (10YR 3/1) clay films on faces of peds; neutral; clear smooth boundary.
Bg2—30 to 35 inches; olive gray (5Y 5/2) silty clay; moderate medium angular blocky structure parting to moderate fine angular blocky; firm; few fine distinct light olive brown (2.5Y 5/4) iron concentrations; many olive gray (5Y 4/2) clay films on faces of peds; neutral; clear smooth boundary.
Bkg—35 to 60 inches; light olive gray (5Y 6/2) silty clay loam; weak coarse subangular blocky structure parting to weak fine subangular blocky; firm; common fine prominent yellowish brown (10YR 5/6) iron concentrations; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 26 to 40 inches
Thickness of the mollic epipedon: 16 to 24 inches
Other features: Some pedons have a C horizon, which consists of alternating strata of silty clay and silty clay loam and silt loam.

Ap horizon:
Hue—neutral or 10YR
Value—2
Chroma—0 or 1
Texture—silty clay loam

A horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam or silty clay

Bg horizon:
Hue—2.5Y or 5Y
Value—4 or 5
Chroma—1 or 2
Texture—silty clay loam or silty clay

Bkg horizon:
Hue—5Y
Value—5 or 6
Chroma—2
Texture—silty clay loam or silty clay

229—Waldorf silty clay loam, 0 to 2 percent slopes

Composition

Waldorf and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Drainageways and flats on lake plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine deposits
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.9 inches (high)
Content of organic matter in the surface layer: About 7 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Lura and similar soils
- Collinwood and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

W—Water

Composition

Water: 100 percent

Description of the Unit

- Naturally occurring basins of surface water

1356—Water, miscellaneous

Composition

Water: 100 percent

Description of the Unit

- Small manmade areas that are used for industrial, sanitary, or mining applications and that contain water most of the year

Webster Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Moraines
Parent material: Till or lacustrine deposits over till
Slope range: 0 to 2 percent
Taxonomic classification: Fine-loamy, mixed, mesic Typic Endoaquolls

Typical Pedon

Webster clay loam, 0 to 2 percent slopes, 2,100 feet south and 1,100 feet west of the northeast corner of sec. 26, T. 117 N., R. 31 W.

Ap—0 to 9 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; cloddy; friable; 1 percent gravel; neutral; clear smooth boundary.

A—9 to 17 inches; black (N 2/0) clay loam, dark gray (N 4/0) dry; weak fine subangular blocky structure parting to weak very fine subangular blocky; friable; about 1 percent gravel; neutral; gradual smooth boundary.

Bg—17 to 24 inches; olive gray (5Y 4/2) clay loam; weak medium subangular blocky structure parting to weak fine subangular blocky; friable; very many dark olive gray (5Y 3/2) organic coatings on faces of peds and in pores; 2 percent gravel; about 2 percent cobbles and stones; neutral; clear smooth boundary.

Bkg—24 to 60 inches; olive gray (5Y 5/2) loam; weak coarse subangular blocky structure parting to weak thin platy; friable; common fine prominent light olive brown (2.5Y 5/6) iron concentrations; 1 percent gravel; 3 percent cobbles and stones; common fine irregular soft white (10YR 8/2) masses and threads of calcium carbonate distributed uniformly throughout the horizon; strongly effervescent; slightly alkaline.

Range in Characteristics

Depth to carbonates: 20 to 40 inches
Thickness of the mollic epipedon: 14 to 24 inches

A horizon:
Hue—10YR or neutral
Value—2
Chroma—0 or 1
Texture—clay loam or silty clay loam
Content of rock fragments—1 to 2 percent gravel; 0 to 1 percent cobbles and stones

Bg horizon:
Hue—5Y or 2.5Y
Value—4 or 5
Chroma—1 or 2
Texture—clay loam or silty clay loam in the upper part; clay loam in the lower part
Content of rock fragments—2 to 4 percent gravel; 1 to 2 percent cobbles and stones

Bkg horizon:
Hue—5Y or 2.5Y
Value—4 to 6
Chroma—1 to 3
Texture—dominantly loam or sandy loam; clay loam in some pedons
Content of rock fragments—2 to 4 percent gravel; 1 to 4 percent cobbles and stones

113—Webster clay loam, 0 to 2 percent slopes

Composition

Webster and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Drainageways and flats on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.5 inches (high)
Content of organic matter in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Glencoe and similar soils
- Nicollet and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

1101—Webster silty clay loam, moderately fine substratum, 0 to 2 percent slopes

Composition

Webster and similar soils: About 85 percent
Inclusions: About 15 percent

Setting

Landform: Flats and swales on moraines
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Lacustrine deposits over till
Flooding: None
Depth to the water table: 0.5 foot to 1.5 feet
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 10.6 inches (high)
Content of organic matter in the surface layer: About 5.5 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Okoboji and similar soils
- Nicollet and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

Zook Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Flood plains
Parent material: Alluvium
Slope range: 0 to 2 percent
Taxonomic classification: Fine, montmorillonitic, mesic Cumulic Vertic Endoaquolls

Typical Pedon

Zook silty clay loam, 0 to 2 percent slopes, occasionally flooded, 2,300 feet east and 1,700 feet north of the southwest corner of sec. 18, T. 120 N., R. 29 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; moderate medium angular blocky structure; friable; neutral; abrupt smooth boundary.

A1—10 to 28 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; moderate fine angular blocky structure parting to strong very fine angular blocky; firm; neutral; clear smooth boundary.

A2—28 to 41 inches; very dark gray (N 3/0) silty clay, dark gray (N 4/0) dry; moderate fine angular blocky structure parting to strong very fine angular blocky; firm; neutral; clear smooth boundary.

Bg1—41 to 48 inches; gray (5Y 5/1) silty clay loam; weak medium angular blocky structure parting to moderate very fine angular blocky; friable; many medium prominent light yellowish brown (10YR 5/6) iron concentrations; few very dark gray (N 3/0) root channels; neutral; clear smooth boundary.

Bg2—48 to 60 inches; gray (5Y 5/1) silty clay loam; weak medium angular blocky structure; friable; neutral.

Range in Characteristics

Depth to carbonates: Greater than 50 inches
Thickness of the mollic epipedon: 36 to 48 inches

Ap horizon:
Hue—neutral or 10YR
Value—2
Chroma—0 or 1
Texture—silty clay loam

A horizon:
Hue—neutral or 10YR
Value—2 or 3
Chroma—0 or 1
Texture—silty clay loam or silty clay

Bg horizon:
Hue—5Y or 10YR
Value—3 to 5
Chroma—1
Texture—silty clay loam or silty clay

664—Zook silty clay loam, 0 to 2 percent slopes, occasionally flooded

Composition

Zook and similar soils: About 90 percent
Inclusions: About 10 percent

Setting

Landform: Flats and slight rises on flood plains
Slope range: 0 to 2 percent

Component Description

Surface layer texture: Silty clay loam
Depth to bedrock: Greater than 60 inches
Drainage class: Poorly drained
Dominant parent material: Alluvium
Flooding: Occasional
Seasonal high water table: At the surface to 1 foot below the surface
Kind of water table: Apparent
Available water capacity to 60 inches or root-limiting layer: About 9.1 inches (high)
Content of organic matter in the surface layer: About 6 percent (high)

A typical soil series description with range in characteristics is included, in alphabetical order, in this section. Additional information specific to this map unit, such as horizon depth and textures, is available in the "Soil Properties" section in Part II of this publication.

Inclusions

- Calco and similar soils

Major Uses of the Unit

- Cropland
- Pasture

For general and detailed information concerning these uses, see Part II of this publication:

- Agronomy section

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Glossary

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Backslope. The geomorphic component that forms the steepest inclined surface and principal element of many hillslopes. Backslopes in profile are commonly steep and linear and descend to a footslope. In terms of gradational process, backslopes are erosional forms produced mainly by mass wasting and running water.

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Channery soil material. Soil material that is, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage. Any tillage and planting system in which a cover of crop residue is maintained on at least 30 percent of the surface after planting in order to reduce the hazard of water erosion; in areas where soil blowing is the primary concern, a system that maintains a cover of at least 1,000 pounds of flat residue of small grain or its equivalent during the critical erosion period.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—Readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Delta. A body of alluvium having a surface that is nearly flat and fan shaped; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth, soil. The thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—These soils have very high and high hydraulic conductivity and a low water-holding capacity. They are not suited to crop production unless irrigated.

Somewhat excessively drained.—These soils have high hydraulic conductivity and a low water-holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.

Well drained.—These soils have an intermediate or high water-holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.

Moderately well drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of most field crops are affected. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

Somewhat poorly drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted under natural conditions. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

Poorly drained.—These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poor drainage is caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

Very poorly drained.—These soils are wet to the surface most of the time. The wetness prevents the growth of important crops (except for rice) under natural conditions.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. The term is more often applied to cliffs resulting from differential erosion.

Esker. A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field* *capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, or clay.

Firebreak. An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is generally a constructional landform consisting of sediment deposited during overflow and lateral migration of the stream.

Footslope. The geomorphic component that forms the inner, gently inclined surface at the base of a hillslope. The surface is dominantly concave. In terms of gradational processes, a footslope is a transition zone between an upslope site of erosion (backslope) and a downslope site of deposition (toeslope).

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Geomorphology. The science that treats the general configuration of the earth's surface; specifically the study of the classification, description, nature, origin, and development of landforms and their relationships to underlying structures, and the history of geologic changes as recorded by these surface features. The term is especially applied to the genetic interpretation of landforms.

Glacial drift. Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash. Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glaciofluvial deposits. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water. Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-chroma zones. Zones having chroma of 3 or more. Typical color in areas of iron concentrations.

High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 6 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Ice-walled lake plain. A relict surface marking the floor of an extinct lake basin that was formed on solid ground and surrounded by stagnant ice in a stable or unstable superglacial environment on stagnation moraines. As the ice melted, the lake plain became perched above the adjacent landscape. The lake plain is well sorted, generally fine textured, stratified deposits.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Iron concentrations. High-chroma zones having a high content of iron and manganese oxide because of chemical oxidation and accumulation, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic concentration.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame. An irregular, short ridge or hill of stratified glacial drift.

Karst (topography). The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake bed. The bottom of a lake; a lake basin.

Lake plain. A nearly level surface marking the floor of an extinct lake filled by well sorted, generally fine textured, stratified deposits, commonly containing varves.

Lakeshore. A narrow strip of land in contact with or bordering a lake; especially the beach of a lake.

Lake terrace. A narrow shelf, partly cut and partly built, produced along a lakeshore in front of a scarp line of low cliffs and later exposed when the water level falls.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low-chroma zones. Zones having chroma of 2 or less. Typical color in areas of iron depletions.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine. An accumulation of glacial drift in a topographic landform resulting chiefly from the direct action of glacial ice. Some types are lateral, recessional, and terminal.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mudstone. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil ir various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Outwash plain. An extensive area of glaciofluvial material that was deposited by meltwater streams

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment. A thin layer of alluvial material that mantles an erosion surface and has been transported to its present position from higher lying areas of the erosion surface.

Pedon. The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Extremely slow	less than 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	less than 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Salty water (in tables). Water that is too salty for consumption by livestock.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saprolite. Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Second bottom. The first terrace above the normal flood plain (or first bottom) of a river.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder. The hillslope position that forms the uppermost inclined surface near the top of a hillslope. It comprises the transition zone from backslope to summit. The surface is dominantly convex in profile and erosional in orgin.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Sloughed till. Water-saturated till that has flowed slowly downhill from its original place of deposit by glacial ice. It may rest on other till, on glacial outwash, or on a glaciolacustrine deposit.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of rock fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are: *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter or loosen a layer that restricts roots.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summit. The topographically highest position of a hillslope profile and exhibiting a nearly level surface. A general term for the top, or highest level of a landform, such as a hill, mountain, or tableland. It usually refers to a high interfluve area of gentler slope that is flanked by steeper hillslopes, for example, mountain fronts or tableland escarpments.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Swale. A slight depression in the midst of generally level land. A shallow depression in an undulating ground moraine due to uneven glacial deposition.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till. Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Till plain. An extensive area of nearly level to undulating or gently sloping soils that are underlain by till or consist of till. Slopes are 0 to 6 percent.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope. The outermost inclined surface at the base of a hill. Toeslopes are commonly gentle and linear in profile.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as salts, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The uprooting and tipping over of trees by the wind.

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In cooperation with
the Minnesota Agricultural
Experiment Station

Soil Survey of Meeker County, Minnesota

Part II

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How to Use This Soil Survey

This survey is divided into three parts. Part I includes general information about the survey area; descriptions of the general soil map units, detailed soil map units, and soil series in the area; and a description of how the soils formed. Part II describes the use and management of the soils and the major soil properties. This part may be updated as further information about soil management becomes available. Part III includes the maps.

On the **general soil map**, the survey area is divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** in Part I of this survey for a general description of the soils in your area.

The **detailed soil maps** can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**. Note the number of the map sheet, and turn to that sheet.

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** in Part I of this survey, which lists the map units by symbol and name and shows the page where each map unit is described.

The **Contents** in Part II shows which table has data on a specific land use for each detailed soil map unit. See the **Contents** in Part I and Part II for other sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1992. Soil names and descriptions were approved in 1996. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1992. This survey was made cooperatively by the Natural Resources Conservation Service, the Minnesota Agricultural Experiment Station, the Agricultural Extension Service, the Minnesota Department of Natural Resources, and the Board of Water and Soil Resources. The survey is part of the technical assistance furnished to the Meeker County Soil and Water Conservation District. Partial funding was provided by the Legislative Commission on Minnesota Resources and by the Meeker County Board of Commissioners.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

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Cover: This nearly level to gently undulating landscape is in an area of Cosmos, Kandiyohi, Lura, and Strout soils in the southern part of Meeker County.

Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service home page on the World Wide Web. The address is http://www.nrcs.usda.gov (click on "Technical Resources").

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Soil Survey of
Meeker County, Minnesota

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Interpretive ratings help engineers, planners, and others understand how soil properties influence important nonagricultural uses, such as building site development and construction materials. The ratings indicate the most restrictive soil features affecting the suitability of the soils for these uses.

Soils are rated in their natural state. No unusual modification of the soil site or material is made other than that which is considered normal practice for the rated use. Even though soils may have limitations, it is important to remember that engineers and others can modify soil features or can design or adjust the plans for a structure to compensate for most of the limitations. Most of these practices, however, are costly. The final decision in selecting a site for a particular use generally involves weighing the costs of site preparation and maintenance.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The classification and extent of the soils in this survey area are shown in the tables “Classification of the Soils” and “Acreage and Proportionate Extent of the Soils,” which are at the end of this section.

Classification of the Soils

Soil name	Family or higher taxonomic class
Angus	Mollic Hapludalfs, fine-loamy, mixed, mesic
Arkton	Aquic Hapludolls, fine-loamy, mixed, mesic
Barry	Typic Argiaquolls, fine-loamy, mixed, mesic
Biscay	Typic Endoaquolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Blue Earth	Mollic Fluvaquents, fine-silty, mixed (calcareous), mesic
Bold	Typic Udorthents, coarse-silty, mixed (calcareous), mesic
Calco	Cumulic Haplaquolls, fine-silty, mixed (calcareous), mesic
Canisteo	Typic Endoaquolls, fine-loamy, mixed (calcareous), mesic
Chelsea	Argic Udipsamments, mixed, mesic
Clarion	Typic Hapludolls, fine-loamy, mixed, mesic
Cohoctah	Fluvaquentic Endoaquolls, coarse-loamy, mixed, mesic
Cokato	Typic Argiudolls, fine-loamy, mixed, mesic
Collinwood	Aquertic Hapludolls, fine, montmorillonitic, mesic
Cordova	Typic Argiaquolls, fine-loamy, mixed, mesic
Corvuso	Typic Calciaquolls, fine, mesic
Cosmos	Vertic Epiaquolls, fine, montmorillonitic, mesic
Crowriver	Typic Calciaquolls, coarse-loamy, mesic
Cylinder	Aquic Hapludolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Danielson	Cumulic Vertic Epiaquolls, fine, montmorillonitic, mesic
Darfur	Typic Endoaquolls, coarse-loamy, mixed, mesic
Dassel	Typic Endoaquolls, coarse-loamy, mixed, mesic
Dickman	Typic Hapludolls, sandy, mixed, mesic
Estherville	Typic Hapludolls, sandy, mixed, mesic
Fieldon	Typic Endoaquolls, coarse-loamy, mixed (calcareous), mesic
Forestcity	Typic Argiaquolls, fine-loamy, mixed, mesic
Gardencity	Typic Hapludolls, coarse-loamy, mixed, mesic
Glencoe	Cumulic Endoaquolls, fine-loamy, mixed, mesic
Granby	Typic Endoaquolls, sandy, mixed, mesic
Grovecity	Aquic Hapludolls, coarse-loamy, mixed, mesic
Hamel	Typic Argiaquolls, fine-loamy, mixed, mesic
Harps	Typic Calciaquolls, fine-loamy, mesic
Havelock	Cumulic Endoaquolls, fine-loamy, mixed (calcareous), mesic
Hawick	Entic Hapludolls, sandy, mixed, mesic
Houghton	Typic Medisaprists, euic, mesic
Kanaranzi	Typic Hapludolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Kandiyohi	Aquertic Hapludolls, fine, montmorillonitic, mesic
Kingston	Aquic Hapludolls, fine-silty, mixed, mesic
Klossner	Terric Medisaprists, loamy, mixed, euic, mesic
Koronis	Mollic Hapludalfs, fine-loamy, mixed, mesic
Lester	Mollic Hapludalfs, fine-loamy, mixed, mesic
Le Sueur	Aquic Argiudolls, fine-loamy, mixed, mesic
Litchfield	Aquic Hapludolls, sandy, mixed, mesic
Lundlake	Cumulic Endoaquolls, fine-loamy, mixed, mesic
Lura	Cumulic Vertic Epiaquolls, fine, montmorillonitic, mesic
Madelia	Typic Endoaquolls, fine-silty, mixed, mesic
Marcellon	Aquic Argiudolls, fine-loamy, mixed, mesic
Mayer	Typic Endoaquolls, fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic
Medo	Terric Medisaprists, loamy, mixed, euic, mesic
Minneopa	Aquic Hapludolls, sandy, mixed, mesic
Muskego	Limnic Medisaprists, coprogenous, euic, mesic
Newlondon	Aquic Eutrochrepts, fine-loamy, mixed, mesic
Nicollet	Aquic Hapludolls, fine-loamy, mixed, mesic
Okoboji	Cumulic Vertic Endoaquolls, fine, montmorillonitic, mesic
Omsrud	Typic Hapludolls, fine-loamy, mixed, mesic
Reedslake	Typic Argiudolls, fine-loamy, mixed, mesic
Rohrbeck	Arenic Hapludalfs, loamy, mixed, mesic
Rolfe	Typic Argialbolls, fine, montmorillonitic, mesic
Seaforth	Aquic Calciudolls, fine-loamy, mixed, mesic
Shorewood	Aquertic Argiudolls, fine, montmorillonitic, mesic
Sparta	Entic Hapludolls, sandy, mixed, mesic
Spicer	Typic Endoaquolls, fine-silty, mixed (calcareous), mesic
Storden	Typic Eutrochrepts, fine-loamy, mixed, mesic
Strout	Vertic Hapludolls, fine, montmorillonitic, mesic
Sunburg	Typic Udorthents, coarse-loamy, mixed (calcareous), mesic

Classification of the Soils--Continued

Soil name	Family or higher taxonomic class
Swanlake	Typic Calciudolls, fine-loamy, mixed, mesic
Swedegrove	Typic Endoaquolls, coarse-loamy, mixed (calcareous), mesic
Truman	Typic Hapludolls, fine-silty, mixed, mesic
Udipsamments	Udipsamments
Udorthents	Udorthents
Uniongrove	Typic Endoaquolls, coarse-loamy, mixed, mesic
Wadena	Typic Hapludolls, fine-loamy over sandy or sandy-skeletal, mixed, mesic
Wadenill	Typic Hapludolls, coarse-loamy, mixed, mesic
Waldorf	Vertic Epiaquolls, fine, montmorillonitic, mesic
Webster	Typic Endoaquolls, fine-loamy, mixed, mesic
Zook	Cumulic Vertic Endoaquolls, fine, montmorillonitic, mesic

Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
8B	Sparta loamy sand, 1 to 6 percent slopes	3,361	0.8
8C	Sparta loamy sand, 6 to 12 percent slopes	992	0.2
8D	Sparta loamy sand, 12 to 25 percent slopes	547	0.1
35	Blue Earth mucky silt loam, 0 to 1 percent slopes	1,195	0.3
39A	Wadena loam, 0 to 2 percent slopes	1,234	0.3
41A	Estherville sandy loam, 0 to 2 percent slopes	5,820	1.4
85	Calco silty clay loam, 0 to 2 percent slopes, occasionally flooded	1,320	0.3
86	Canisteo clay loam, moderately fine substratum, 0 to 2 percent slopes	2,709	0.7
96B	Collinwood silty clay loam, 3 to 6 percent slopes	1,555	0.4
101B	Truman silt loam, 2 to 6 percent slopes	2,339	0.6
102B	Clarion loam, moderately fine substratum, 2 to 5 percent slopes	4,787	1.2
106C2	Lester loam, 6 to 12 percent slopes, eroded	1,737	0.4
112	Harps clay loam, 0 to 2 percent slopes	1,317	0.3
113	Webster clay loam, 0 to 2 percent slopes	4,327	1.0
114	Glencoe clay loam, depressional, 0 to 1 percent slopes	1,610	0.4
129	Cylinder loam, 0 to 1 percent slopes	1,088	0.3
130	Nicollet clay loam, 1 to 3 percent slopes	3,798	0.9
134	Okoboji silty clay loam, depressional, 0 to 1 percent slopes	3,246	0.8
136	Madelia silty clay loam, 0 to 2 percent slopes	2,750	0.7
140	Spicer silty clay loam, 0 to 2 percent slopes	2,800	0.7
143B	Chelsea loamy fine sand, 1 to 6 percent slopes	762	0.2
178	Granby fine sandy loam, 0 to 1 percent slopes	1,196	0.3
181	Litchfield loamy fine sand, 0 to 2 percent slopes	3,836	0.9
183	Dassel mucky fine sandy loam, depressional, 0 to 1 percent slopes	323	*
197	Kingston silty clay loam, 1 to 3 percent slopes	3,512	0.9
211	Lura silty clay, depressional, 0 to 1 percent slopes	2,933	0.7
229	Waldorf silty clay loam, 0 to 2 percent slopes	2,728	0.7
239	Le Sueur clay loam, 1 to 3 percent slopes	1,823	0.4
281	Darfur loam, 0 to 2 percent slopes	2,363	0.6
286B	Shorewood silty clay loam, 3 to 6 percent slopes	1,299	0.3
311C2	Shorewood silty clay, 6 to 12 percent slopes, eroded	827	0.2
327A	Dickman sandy loam, 0 to 2 percent slopes	3,671	0.9
327B	Dickman sandy loam, 2 to 6 percent slopes	1,599	0.4
399	Biscay loam, depressional, 0 to 1 percent slopes	442	0.1
415	Kanaranzi loam, 0 to 3 percent slopes	4,409	1.1
423	Seaforth loam, 1 to 3 percent slopes	1,909	0.5
461B	Koronis loam, 2 to 6 percent slopes	19,382	4.7
461C2	Koronis loam, 6 to 12 percent slopes, eroded	8,792	2.1
511	Marcellon loam, 0 to 3 percent slopes	7,567	1.8
523	Houghton muck, depressional, 0 to 1 percent slopes	441	0.1
525	Muskego muck, depressional, 0 to 1 percent slopes	1,047	0.3
539	Klossner muck, depressional, 0 to 1 percent slopes	3,920	0.9
548	Medo muck, depressional, 0 to 1 percent slopes	600	0.1
610	Calco silty clay loam, 0 to 1 percent slopes, frequently flooded	1,178	0.3
611D	Hawick gravelly sandy loam, 12 to 25 percent slopes	1,128	0.3
612B	Wadenill loam, 2 to 6 percent slopes	6,564	1.6
613	Grovecity loam, 1 to 3 percent slopes	5,545	1.3
664	Zook silty clay loam, 0 to 2 percent slopes, occasionally flooded	586	0.1
740	Hamel-Glencoe, depressional, complex, 0 to 3 percent slopes	6,903	1.7
804B	Koronis-Sunburg-Hawick complex, 2 to 6 percent slopes	1,168	0.3
804C2	Koronis-Sunburg-Hawick complex, 6 to 12 percent slopes, eroded	1,997	0.5
804D2	Koronis-Sunburg-Hawick complex, 12 to 18 percent slopes, eroded	1,021	0.2
804E	Koronis-Sunburg-Hawick complex, 18 to 40 percent slopes	1,509	0.4
805C2	Sunburg-Wadenill complex, 6 to 12 percent slopes, eroded	4,222	1.0
805D2	Sunburg-Wadenill complex, 12 to 18 percent slopes, eroded	1,105	0.3
807D2	Koronis-Sunburg complex, 12 to 18 percent slopes, eroded	2,674	0.6
875B	Estherville-Hawick complex, 2 to 6 percent slopes	7,229	1.8
875C	Hawick-Estherville complex, 6 to 12 percent slopes	1,980	0.5
887B	Clarion-Swanlake complex, 2 to 6 percent slopes	7,263	1.8
899	Harps-Okoboji, depressional, complex, 0 to 2 percent slopes	4,467	1.1
909C2	Bold-Truman complex, 6 to 12 percent slopes, eroded	954	0.2
909D2	Bold-Truman complex, 12 to 18 percent slopes, eroded	325	*

See footnote at end of table.

Acreage and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
920B	Clarion-Storden-Hawick complex, 2 to 6 percent slopes	1,011	0.2
945D2	Lester-Storden complex, 12 to 18 percent slopes, eroded	1,003	0.2
945E	Lester-Storden complex, 18 to 40 percent slopes	1,595	0.4
956	Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes	9,838	2.4
960C2	Storden-Omsrud complex, 6 to 12 percent slopes, eroded	9,805	2.4
960D2	Storden-Omsrud complex, 12 to 18 percent slopes, eroded	4,655	1.1
978	Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes	683	0.2
1015	Udipsamments (cut and fill land)	558	0.1
1016	Udorthents, loamy (cut and fill land)	788	0.2
1030	Pits, gravel-Udipsamments complex	558	0.1
1080	Klossner, Okoboji, and Glencoe soils, ponded, 0 to 1 percent slopes	6,223	1.5
1096	Fieldon-Dassel, depressional, complex, 0 to 2 percent slopes	4,302	1.0
1097	Mayer-Biscay, depressional, complex, 0 to 2 percent slopes	5,668	1.4
1098	Biscay-Biscay, depressional, complex, 0 to 2 percent slopes	3,134	0.8
1099	Granby loamy fine sand, very wet, 0 to 1 percent slopes	621	0.2
1100	Nicollet silty clay loam, 1 to 3 percent slopes	4,560	1.1
1101	Webster silty clay loam, moderately fine substratum, 0 to 2 percent slopes	5,287	1.3
1159B	Strout-Arkton complex, 2 to 6 percent slopes	4,769	1.2
1161	Barry loam, 0 to 2 percent slopes	3,609	0.9
1162A	Kandiyohi clay, 0 to 2 percent slopes	4,506	1.1
1162B	Kandiyohi clay, 2 to 5 percent slopes	4,013	1.0
1163	Cohoctah loam, 0 to 2 percent slopes, frequently flooded	3,743	0.9
1165	Lundlake silty clay loam, depressional, 0 to 1 percent slopes	3,236	0.8
1168	Swedegrove-Lundlake, depressional, complex, 0 to 2 percent slopes	9,982	2.4
1169	Corvuso-Lura, depressional, complex, 0 to 2 percent slopes	3,724	0.9
1171C	Newlondon-Strout complex, 6 to 12 percent slopes, eroded	4,596	1.1
1171D	Newlondon-Strout complex, 12 to 18 percent slopes, eroded	1,074	0.3
1172C	Sparta-Gardencity complex, 6 to 12 percent slopes	445	0.1
1173	Muskego and Klossner soils, depressional, 0 to 1 percent slopes, frequently flooded	3,398	0.8
1174	Danielson clay loam, 1 to 3 percent slopes	4,900	1.2
1175	Swedegrove loam, 0 to 2 percent slopes	4,889	1.2
1176	Litchfield sandy loam, 0 to 2 percent slopes	1,009	0.2
1177C	Gardencity-Bold complex, 6 to 12 percent slopes, eroded	501	0.1
1178	Uniongrove loam, 0 to 2 percent slopes	8,365	2.0
1183	Crowriver loam, 0 to 2 percent slopes	5,911	1.4
1184	Corvuso silty clay loam, 0 to 2 percent slopes	2,320	0.6
1185	Gardencity fine sandy loam, moderately wet, 0 to 2 percent slopes	729	0.2
1186	Forestcity-Lundlake, depressional, complex, 0 to 3 percent slopes	8,250	2.0
1192	Crowriver-Lundlake, depressional, complex, 0 to 2 percent slopes	1,714	0.4
1193	Cosmos silty clay, 0 to 2 percent slopes	7,598	1.8
1197	Cohoctah fine sandy loam, 0 to 2 percent slopes, occasionally flooded	598	0.1
1198B	Rohrbeck-Koronis complex, 1 to 6 percent slopes	1,355	0.3
1199	Klossner and Lundlake soils, ponded	5,478	1.3
1203	Muskego, Blue Earth, and Houghton soils, ponded	21,417	5.2
1204B	Reedslake loam, 2 to 5 percent slopes	10,856	2.6
1213C	Cokato-Storden complex, 6 to 12 percent slopes, eroded	4,298	1.0
1220C	Cokato-Storden-Hawick complex, 6 to 12 percent slopes, eroded	1,490	0.4
1356	Water, miscellaneous	85	*
1362B	Angus loam, 2 to 5 percent slopes	2,019	0.5
1383A	Shorewood silty clay loam, moderately wet, 0 to 3 percent slopes	817	0.2
1384	Minneopa loam, 0 to 2 percent slopes	2,575	0.6
1385	Havelock loam, 0 to 2 percent slopes, frequently flooded	31	*
1387A	Collinwood silty clay loam, moderately wet, 0 to 3 percent slopes	1,580	0.4
1391B	Wadenill-Sunburg complex, 2 to 6 percent slopes	4,971	1.2
1406	Medo, Dassel, and Biscay soils, ponded, 0 to 1 percent slopes	3,699	0.9
1801B	Gardencity very fine sandy loam, 2 to 6 percent slopes	1,971	0.5
W	Water	13,800	3.3
	Total	412,900	100.0

* Less than 0.1 percent.

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Agronomy

General management needed for crops and for hay and pasture is suggested in this section. The system of land capability classification used by the Natural Resources Conservation Service is explained, and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider obtaining specific information from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Cropland Management Considerations

Dale A. Johnson, soil conservationist, Natural Resources Conservation Service, helped prepare this section.

According to the Minnesota Agricultural Statistics Service, approximately 250,000 acres in Meeker County was used for cropland in 1991. Of this acreage, about 115,500 acres was used for corn as grain and 8,400 acres for corn as silage; about 68,400 acres was used for soybeans; about 27,300 acres was used for oats and wheat; and about 22,500 acres was used for hay and alfalfa. About 7,000 acres was used for edible beans, peas, sugar beets, and sweet corn.

The management concerns affecting the use of the detailed soil map units in the survey area for crops are shown in the table "Cropland Management Considerations." The main concerns in managing nonirrigated cropland are conserving moisture, controlling soil blowing and water erosion, and maintaining soil fertility. Other concerns include preventing surface compaction, controlling ponding or flooding, and improving internal drainage conditions.

About 7 percent of the soils used as cropland have very few limitations that affect this use. These soils are nearly level and are not significantly susceptible to erosion or wetness. Examples are Nicollet, Grovecity, and Kingston soils.

About 23 percent of the cropland soils have gentle slopes that are subject to water erosion and surface runoff. Water erosion and surface runoff are detrimental for two reasons. First, as topsoil is removed by erosion, nutrients and organic matter are lost. Second, the sediment produced by erosion settles at the base of slopes or in nearby depressions or enters rivers and lakes. This sedimentation affects water quality. Clarion, Koronis, and Truman soils on B and C slopes are examples of soils subject to water erosion. Water erosion on these soils can be controlled by returning crop residue to the surface and by using conservation tillage practices, such as chisel plowing, ridge till, or no-till. The benefits of conservation tillage include erosion control, reduced fuel consumption, and a substantial savings of time.

Approximately 14 percent of the cropland is in sloping or moderately steep areas. Koronis, Sunburg, Truman, and Bold soils on C and D slopes are examples of steep soils that are highly susceptible to erosion. Conservation practices are needed to control erosion in these areas. These practices include terraces, diversions, waterways, stripcropping, conservation tillage, and contour farming. Planting trees and seeding the steeper areas to a permanent cover of grass or hay are additional conservation practices that can be used in these areas. Returning crop residue to the soil increases the rate of water infiltration, reduces the runoff rate, and helps to control erosion. In areas where water concentrates as it flows downslope, grassed waterways may be needed (fig. 1).

About 11 percent of the soils used for cropland are subject to soil blowing. Estherville, Hawick, and Sparta soils are examples. Properly placed field windbreaks and a system of conservation tillage that leaves the surface rough and maintains a cover of crop residue are the most effective erosion-control practices in areas of these soils.

About 9 percent of the county consists of droughty soils (fig. 2). Measures that conserve moisture are needed in areas of these soils. These measures include controlling soil blowing, controlling runoff, increasing the rate of water infiltration, and controlling weeds. Stripcropping, managing crop residue, and planting early maturing crops are practices that conserve moisture.

A small acreage in the county is irrigated. Wells are the main source of irrigation water. Management

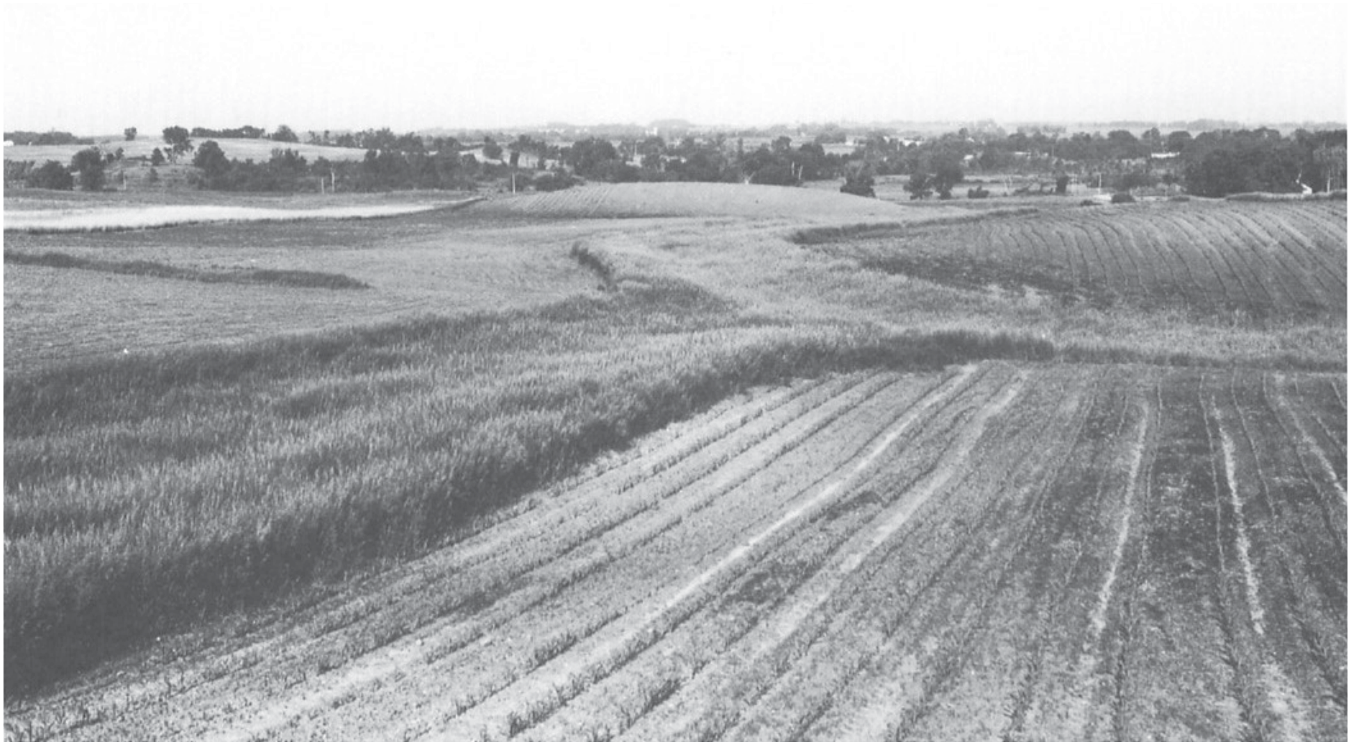

Figure 1.—A grassed waterway in an area of Forestcity-Lundlake, depressional, complex, 0 to 3 percent slopes.

factors that should be considered when irrigation systems are planned include the type of soil, the amount and quality of water needed, the type of irrigation system needed, drainage, preparation, and the overall management of the land. Good irrigation management includes the proper amount and timing of water applications and the even distribution of irrigation water. Also, fertilizer is needed in most irrigated areas if the crops are to benefit fully from irrigation.

About 32 percent of the cropland in the county consists of poorly drained soils, such as Canisteo, Cosmos, and Webster soils. A proper drainage system is needed on these soils to produce adequate crop yields. The spacing of subsurface drainage lines is dependent upon the soil type and the depth at which the drains can be installed. Generally, the finer the soil texture, the closer the lines should be. Information and guidelines for draining wet soils are available in the local office of the Natural Resources Conservation Service. Nearly all areas of poorly drained soils have been drained by ditches and subsurface drains, but crop yields could be increased in most areas if additional drainage were provided.

About 20 percent of the poorly drained soils are calcareous and have a fertility imbalance caused by high soil pH. Corvuso, Canisteo, Harps, Fieldon, and Spicer soils are examples. Proper crop and variety selection, a good fertility program, and an adequate drainage system are needed on these soils to overcome this imbalance.

About 12 percent of the cropland in the county consists of soils in depressions and soils on flood plains. These soils are capable of producing crops but are subject to ponding or flooding. Examples of these soils are Glencoe, Klossner, Lura, and Okoboji soils in depressions and Calco and Zook soils on flood plains. Open ditches drain much of the surface water and provide outlets for subsurface tile lines. In areas where outlets are not available, a pumping station may be required. Before drainage projects are implemented, Federal and State agencies should be consulted regarding drainage laws and regulations.

Surface compaction can be a problem on about 22 percent of the cropland in the county. Collinwood, Cosmos, Kandiyohi, Shorewood, and Waldorf soils have a high content of clay. If these soils are worked when they are too wet, the surface may become compacted. Tilling only at the proper moisture content helps to prevent the formation of clods. These soils are often tilled in the fall, but fall tillage can increase the hazard of erosion. Returning crop residue to the soil, chisel plowing, and using a rotation that includes alfalfa-grass mixtures help to control erosion, improve soil tilth, and increase the rate of water infiltration.

Natural soil fertility is high in most soils in the county, including Nicollet and Truman soils. About 13 percent of the soils in the county, however, have low fertility. Among these soils are Bold, Storden, Sparta, and Sunburg soils. On most of the soils, crops respond well to applications of fertilizer. Most of the soils in Meeker County are naturally low in phosphorus but generally have adequate amounts of potassium and lime. Soils that formed under woodland vegetation, such as Koronis and Lester soils, tend to be more acid than soils that formed under grass or other kinds of vegetation. These soils respond well to applications of lime in some places.

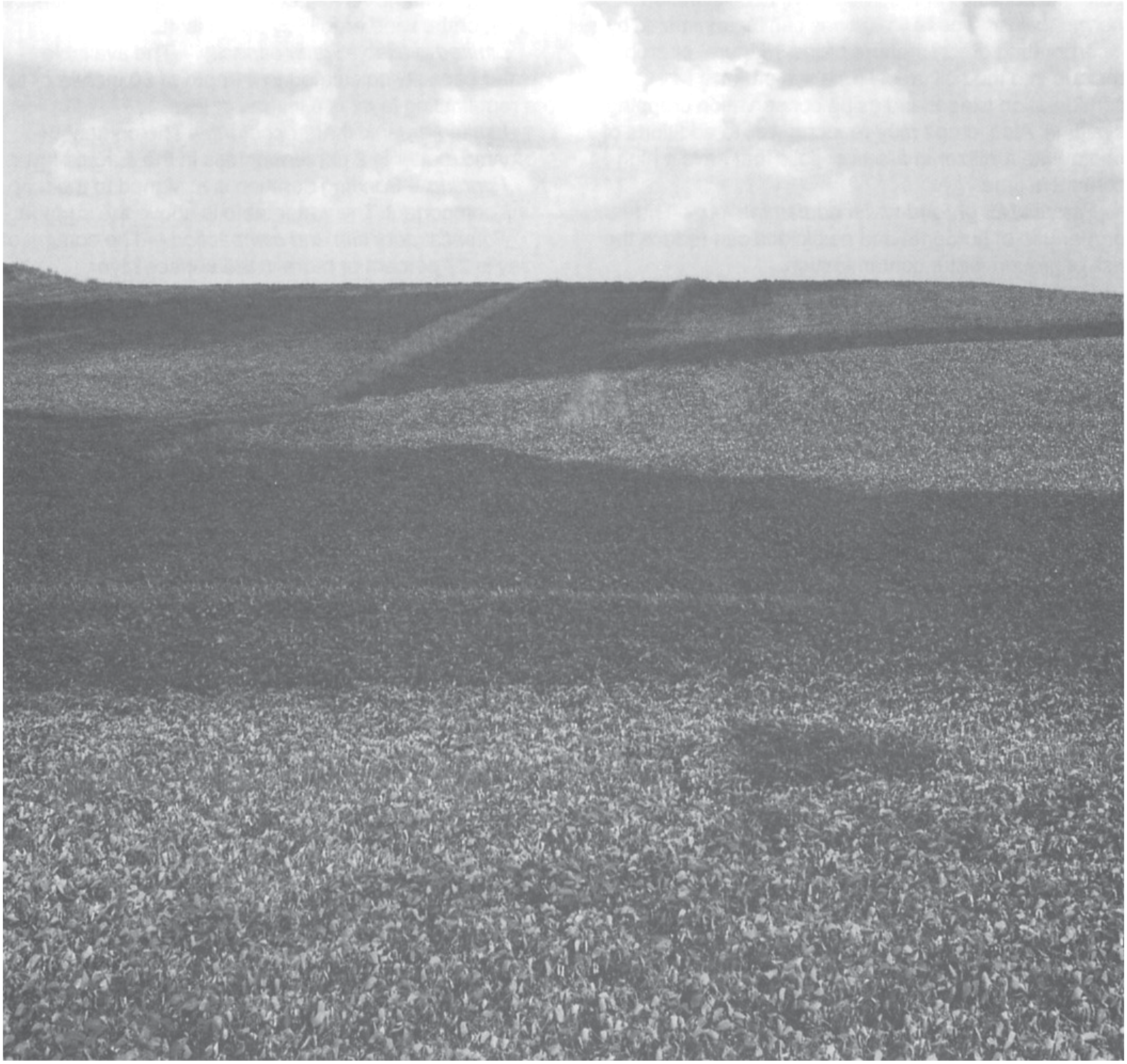

Figure 2.—The lighter colored, drought-stressed soybeans are on the Hawick soil in an area of Hawick-Estherville complex, 6 to 12 percent slopes. The Hawick soil has a low available water capacity.

The need for fertilizer depends on the soil type and on management history, the crops to be grown, and the projected yields. The results of soil tests should be used when decisions about the application of fertilizer are made.

Some of the considerations shown in the table "Cropland Management Considerations" cannot be easily overcome. These are *channels, flooding, gullies,* and *ponding.*

Additional considerations are as follows:

Lime content, limited available water capacity, potential poor tilth and compaction, and restricted permeability.—These limitations can be minimized by incorporating green manure crops, manure, or crop residue into the soil; applying a system of conservation tillage; and using conservation cropping systems. Also, crops may respond well to additions of phosphate fertilizer in areas of soils that have a high content of lime.

Potential for ground-water contamination.—The proper use of nutrients and pesticides can reduce the risk of ground-water contamination.

Potential for surface-water contamination.—The risk of surface-water contamination can be reduced by the proper use of nutrients and pesticides and by conservation farming practices that reduce the runoff rate.

Surface crusting.—This limitation retards seedling development after periods of heavy rainfall.

Surface rock fragments.—This limitation causes rapid wear of tillage equipment. It cannot be easily overcome.

Surface stones.—Stones or boulders on or near the surface can hinder normal tillage unless they are removed.

Salt content.—In areas where this is a limitation, only salt-tolerant crops should be grown.

On irrigated soils the main management concerns are *efficient water use, nutrient management, control of erosion, pest and weed control,* and *timely planting and harvesting* for a successful crop. An irrigation system that provides optimum control and distribution of water at minimum cost is needed. Overirrigation wastes water, leaches plant nutrients, and causes erosion. Also, it can create drainage problems, raise the water table, and increase soil salinity.

Explanation of Criteria

Acid soil.—The pH is less than 6.1.

Channeled.—The word "channeled" is included in the map unit name.

Dense layer.—The bulk density is 1.80 g/cc or greater within the soil profile.

Depth to rock.—The depth to bedrock is less than 40 inches.

Eroded.—The word "eroded" is included in the map unit name.

Excessive permeability.—Permeability is 6 inches per hour or more within the soil profile.

Flooding.—Flooding is occasional or frequent.

Gullied.—The word "gullied" is included in the map unit name.

High organic matter content.—The surface layer has more than 20 percent organic matter.

Lime content.—The pH is 7.4 or more in the surface layer, or the wind erodibility group is 4L.

Limited available water capacity.—The available water capacity calculated to a depth of 60 inches or to a root-limiting layer is 6 inches or less.

Limited organic matter content.—The content of organic matter is 2 percent or less in the surface layer.

Ponding.—Ponding duration is assigned to the map unit component. The water table is above the surface.

Potential poor tilth and compaction.—The content of clay is 27 percent or more in the surface layer.

Potential for ground-water contamination (by nutrients or pesticides).—Depth to the water table is 4 feet or less, the permeability of any layer is more than 6.0 inches per hour, or the depth to bedrock is less than 60 inches.

Potential for surface-water contamination (by nutrients or pesticides).—The map unit component is occasionally flooded or frequently flooded, is subject to ponding, is assigned to hydrologic group C or D and has a slope of more than 2 percent, is assigned to hydrologic group A and has a slope of more than 6 percent, or is assigned to hydrologic group B, has a slope of 3 percent or more, and has a K factor of more than 0.17.

Restricted permeability.—Permeability is less than 0.06 inch per hour within the soil profile.

Salt content.—The electrical conductivity is 4 or more in the surface layer or 8 or more within a depth of 30 inches.

Slope (equipment limitation).—The slope is more than 15 percent.

Surface crusting.—The content of clay is 27 percent or more and the content of organic matter is 2 percent or less in the surface layer.

Surface rock fragments (equipment limitation).—The terms describing the texture of the surface layer include any rock fragment modifier, except for gravelly, channery, stony, very stony, extremely stony, bouldery, very bouldery, and extremely bouldery.

Surface stones (equipment limitation).—The word "stony" or "bouldery" is included in the map unit name or in the description of the surface layer.

Water erosion.—Either the slope is 6 percent or more, or the slope is more than 3 percent and less than 6 percent and the surface layer is not sandy.

Water table.—A water table is within 2.5 feet of the surface.

Wind erosion.—The wind erodibility group is 1, 2, 3, or 4L.

Crop Yield Estimates

The average yields per acre that can be expected of the principal crops under a high level of management are shown in the table "Land Capability and Yields per Acre of Crops and Pasture." In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in the table are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Pasture and Hayland Interpretations

Under good management, proper grazing is essential for the production of high-quality forage, stand survival, and erosion control. Proper grazing helps plants to maintain sufficient and generally vigorous top growth during the growing season. Brush control is essential in many areas, and weed control generally is needed. Rotation grazing and renovation also are important management practices.

Yield estimates are often provided in animal unit months (AUM), or the amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about forage yields other than those shown in the table "Land Capability and Yields per Acre of Crops and Pasture."

About 29,000 acres, or about 7 percent of Meeker County, is used for grazing. The areas used for pasture are generally not conducive to cultivation, mainly because of the slope, the hazard of flooding, or wetness. Some pastures are full of brush or are in otherwise poor condition. Clearing brush and reseeding to more productive species, providing a proper supply of nutrients, and allowing plants to reach the proper height before grazing increase forage yields. Delaying grazing in the spring and during other wet periods, controlling weeds, and clipping mature plants also improve yields. Proper stocking rates and a system of pasture rotation promote the efficient utilization of forage and maintain the sod in good condition (fig. 3). Warm-season grasses can provide good summer pasture and thus enhance full-season grazing.

The soils that are suited to the widest range of pasture species are the well drained to somewhat poorly drained Arkton, Clarion, Collinwood, Cylinder, Gardencity, Kandiyohi, Kingston, Koronis, Lester, Le Sueur, Nicollet, Shorewood, Sunburg, Storden, Truman, Wadena, and Wadenill soils. Cool-season species include alfalfa, birdsfoot trefoil, red clover, smooth bromegrass, timothy, and Kentucky bluegrass. Warm-season grasses, such as big bluestem, indiangrass, and switchgrass, grow well during July and August. All of these species also grow well on the poorly drained Biscay, Corvuso, Calco, Canisteo, Cordova, Cosmos, Crowriver, Darfur, Fieldon, Forestcity, Granby, Hamel, Harps, Madelia, Mayer, Danielson, Spicer, Waldorf, and Webster soils.

The very poorly drained Dassel, Glencoe, Houghton, Klossner, Lura, Lundlake, Muskego, and Okoboji soils and the depressional Biscay soils are suited only to species that are adapted to wet conditions and tolerant of ponding. These species include reed canarygrass, alsike clover, Garrison creeping foxtail, and birdsfoot trefoil. Areas of very

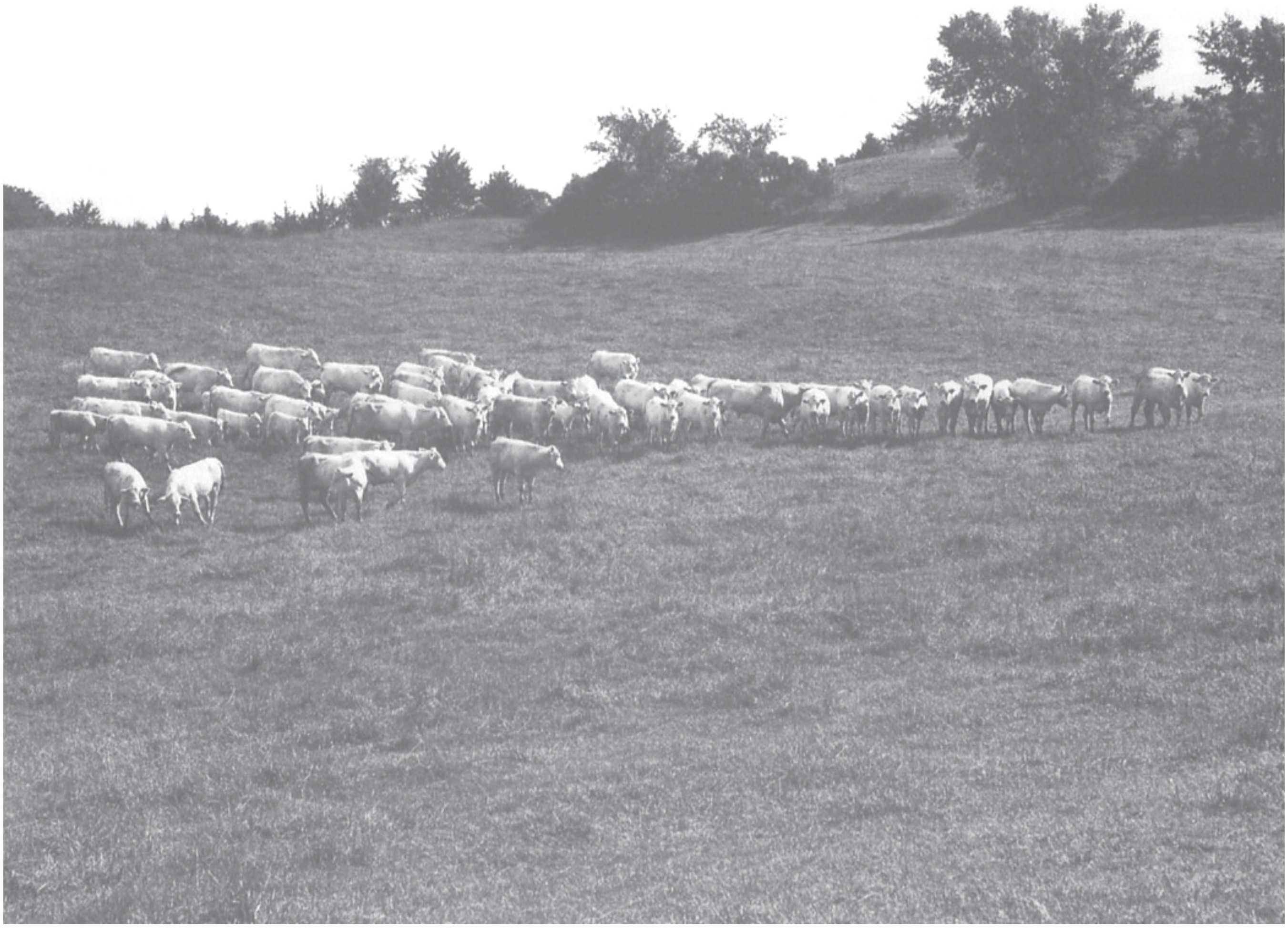

Figure 3.—Cattle grazing in an area of Koronis-Sunburg complex, 12 to 18 percent slopes, eroded. Proper pasture management helps to prevent overgrazing and control erosion.

poorly drained soils can also be used as livestock-watering facilities (fig. 4).

Well drained to excessively drained soils, such as Chelsea, Dickman, Estherville, Hawick, Litchfield, Minneopa, and Sparta soils, generally provide forage during spring and early summer and again in the fall, when precipitation is adequate. During summer, droughty conditions limit forage production. Alfalfa, birdsfoot trefoil, red clover, smooth bromegrass, timothy, orchardgrass, and Kentucky bluegrass grow well when moisture supplies are adequate. Sideoats grama and warm-season grasses, such as big bluestem, little bluestem, indiangrass, and switchgrass, grow well in summer. Current information on variety selection and species adaptation can be obtained from local offices of the Cooperative Extension Service or the Natural Resources Conservation Service.

Good pasture management can include controlling weeds and applying fertilizer. Applications of fertilizer should be based on the results of soil tests. The timely clipping of weedy areas and the use of herbicides help to control weeds.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, woodland, or for engineering purposes.

In the capability system, soils generally are grouped at three levels—capability class, subclass, and unit (USDA, 1961). These categories indicate the degree and kinds of limitations affecting mechanized farming systems that produce the more commonly grown field crops, such as corn, small grain, cotton, hay, and field-grown vegetables. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by numerals 1 through 8. The numerals indicate progressively greater limitations and narrower choices for practical use.

If properly managed, soils in classes 1, 2, 3, and 4 are suitable for the mechanized production of commonly grown field crops and for pasture and woodland. The degree of the soil limitations affecting the production of cultivated crops increases progressively from class 1 to class 4. The limitations can affect levels of production and the risk of permanent soil deterioration caused by erosion and other factors.

Soils in classes 5, 6, and 7 are generally not suited to the mechanized production of commonly grown field crops without special management, but they are suitable for plants that provide a permanent cover, such as grasses and trees. The severity of the soil limitations affecting crops increases progressively from class 5 to class 7.

Areas in class 8 are generally not suitable for crops, pasture, or woodland without a level of management that is impractical. These areas may have potential for other uses, such as recreational facilities and wildlife habitat.

Capability subclasses identify the dominant kind of limitation in the class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, 2e. The letter *e* shows that the main hazard is the risk of erosion unless a close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial

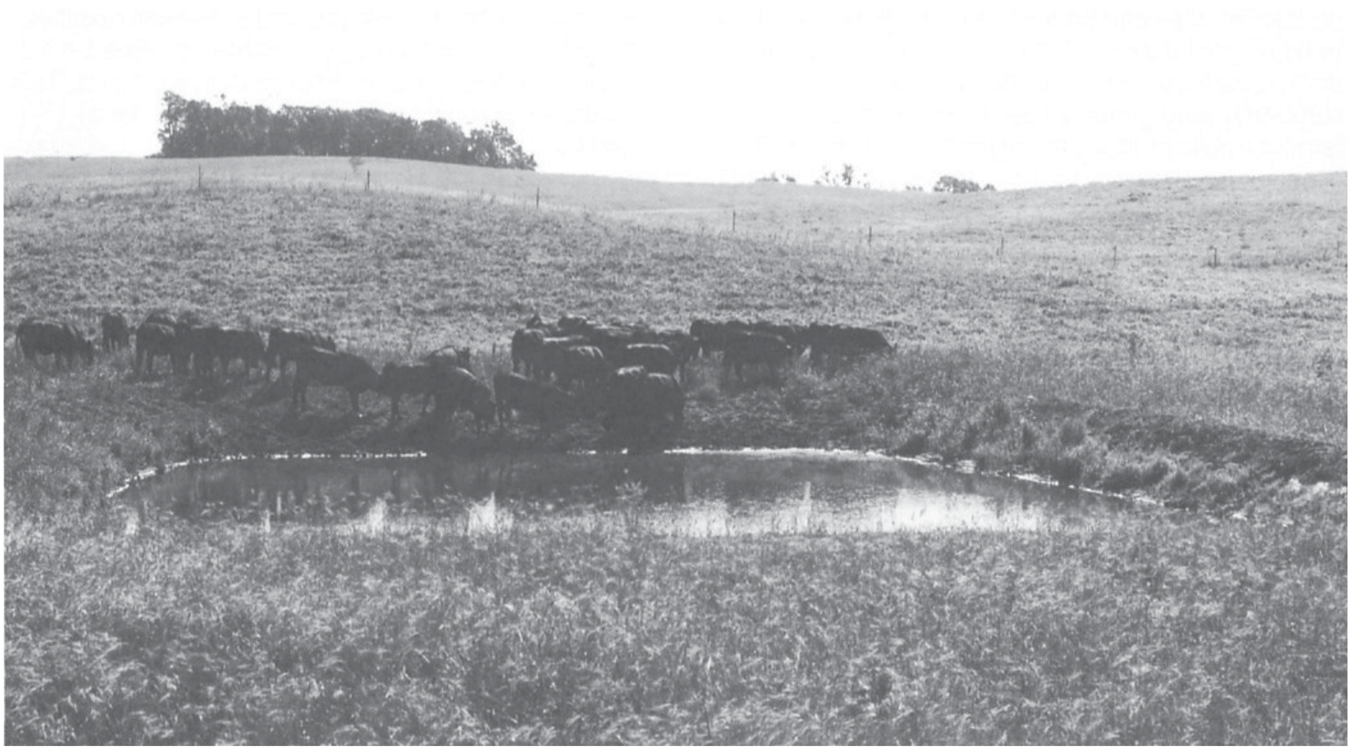

Figure 4.—A livestock-watering facility in a pastured area of Klossner soils. These very poorly drained soils have a seasonal high water table that is close to the surface.

drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

There are no subclasses in class 1 because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w, s,* or *c* because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use mainly to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the table "Land Capability and Yields per Acre of Crops and Pasture" at the end of this section.

Prime Farmland

Prime farmland is of major importance in meeting the Nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, State, and Federal levels, as well as individuals, must encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to food, feed, forage, fiber, and oilseed crops. Such soils have properties that favor the economic production of sustained high yields of crops. The soils need only to be treated and managed by acceptable farming methods. An adequate moisture supply and a sufficiently long growing season are required. Prime farmland soils produce the highest yields with minimal expenditure of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils may presently be used as cropland, pasture, or woodland or for other purposes. They either are used for food and fiber or are available for these uses. Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water-control structures. Public land is land not available for farming in National forests, National parks, military reservations, and State parks.

Prime farmland soils commonly receive an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable, and the level of acidity or alkalinity and the content of salts and sodium are acceptable. The soils have few, if any, rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods, and they are not frequently flooded during the growing season or are protected from flooding. Slopes range mainly from 0 to 6 percent.

Soils that have a high water table or are subject to flooding may qualify as prime farmland where these limitations are overcome by drainage measures or flood control. Onsite evaluation is necessary to determine the effectiveness of corrective measures. More information about the criteria for prime farmland can be obtained at the local office of the Natural Resources Conservation Service.

A recent trend in land use has been the conversion of prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on lands that are less productive than prime farmland.

About 231,292 acres, or nearly 56 percent of the survey area, meets the requirements for prime farmland.

The map units in the survey area that meet the requirements for prime farmland are listed in the table "Prime Farmland." On some soils included in the table, measures that overcome limitations are needed. The need for these measures is indicated in parentheses after the map unit name. The location of each map unit is shown on the detailed soil maps. The soil qualities that affect use and management are described in the section "Soil Series and Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

Erosion Factors

Soil erodibility (K) and soil-loss tolerance (T) factors are used in an equation that predicts the amount of soil lost through water erosion in areas of cropland. The procedure for predicting soil loss is useful in guiding the selection of soil and water conservation practices. The erosion factors for the soils in the survey area are listed in the table "Physical Properties of the Soils."

Soil Erodibility (K) Factor

The soil erodibility (K) factor indicates the susceptibility of a soil to sheet and rill erosion by water. The soil properties that influence erodibility are those that affect the infiltration rate, the movement of water through the soil, and the water storage capacity of the soil and those that allow the soil to resist dispersion, splashing, abrasion, and the transporting forces of rainfall and runoff. The most important soil properties are the content of silt plus very fine sand, the content of sand coarser than very fine sand, the content of organic matter, soil structure, and permeability.

Fragment-Free Soil Erodibility (Kf) Factor

This is one of the factors used in the revised Universal Soil Loss Equation. It shows the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Soil-Loss Tolerance (T) Factor

The soil-loss tolerance (T) factor is an estimate of the maximum annual rate of soil erosion that can occur over a sustained period without affecting crop productivity. The rate is expressed in tons of soil loss per acre per year. Ratings of 1 to 5 are used, depending on soil properties and prior erosion. The criteria used in assigning a T factor to a soil include maintenance of an adequate rooting depth for crop production, potential reduction of crop yields, maintenance of water-control structures affected by sedimentation, prevention of gullying, and the value of nutrients lost through erosion.

Wind Erodibility Groups

Wind erodibility is directly related to the percentage of dry, nonerodible surface soil aggregates larger than 0.84 millimeter in diameter. From this percentage, the wind erodibility index (I) factor is determined. This factor is an expression of the stability of the soil aggregates, or the extent to which they are broken down by tillage and the abrasion caused by windblown soil particles. Soils are assigned to wind erodibility groups (WEG) having similar percentages of dry soil aggregates larger than 0.84 millimeter. The wind erodibility groups and wind erodibility index numbers are listed in the table “Physical Properties of the Soils.”

Additional information about wind erodibility groups and K, Kf, T, and I factors can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service.

Windbreaks and Environmental Plantings

Since the days of the early settlers, windbreaks have been planted to protect farmsteads and livestock. In the 1930’s, they were planted to control soil blowing. In recent years field windbreaks have been planted to trap snow and thus increase the moisture supply. Maximum growth and survival rates can be obtained by controlling weeds around newly planted seedlings.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Windbreaks are often planted on land that did not originally support trees. Knowledge of how trees perform on such land can be gained only by observing and recording the performance of trees that have been planted and have survived. Many popular windbreak species are not indigenous to the areas in which they are planted.

Each tree or shrub species has certain climatic and physiographic limits. Within these parameters, a tree or shrub may grow well or grow poorly, depending on the characteristics of the soil. Each tree or shrub has definable potential heights in a given physiographic area and under a given climate. Accurate definitions of potential heights are necessary when a windbreak is planned and designed.

The table “Windbreaks and Environmental Plantings” shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in this table are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service or from a nursery.

Windbreak Suitability Groups

Windbreak suitability groups consist of soils in which the kinds and degrees of the hazards and limitations that affect the survival and growth of trees and shrubs in windbreaks are about the same. In areas where the hazard of water erosion is severe, site preparation should be limited to spot treatment extending 2 feet from where the plant is established. Specific information also can be obtained from the Meeker County Soil and Water Conservation District, the Natural Resources Conservation Service, or the Meeker County Extension Service.

The windbreak suitability group for each soil in the survey area is listed in the table "Windbreak Suitability Groups" at the end of this section. The following paragraphs explain the characteristics of the soils in each group.

Group 1 consists of soils that are somewhat poorly drained or moderately well drained, are rapidly permeable to moderately slowly permeable, and do not have free carbonates in the upper 20 inches.

Group 1K consists of soils that are somewhat poorly drained or moderately well drained, are rapidly permeable to moderately slowly permeable, and have free carbonates within 20 inches of the surface. These soils may be very slightly saline or slightly saline (the electrical conductivity is 2 to 8).

Group 2 consists of poorly drained and very poorly drained soils that have been artificially drained and do not have free carbonates in the upper 20 inches. Permeability varies.

Group 2K consists of poorly drained or very poorly drained soils that have been artificially drained and have free carbonates within 20 inches of the surface. Permeability varies. These soils may be very slightly saline or slightly saline (the electrical conductivity is 2 to 8).

Group 2H consists of very poorly drained soils that have been artificially drained and have more than 16 inches of organic material. Permeability varies.

Group 2W consists of very poorly drained soils that are subject to ponding and have been artificially drained. It includes soils that have an organic surface layer up to 16 inches thick. Permeability varies.

Group 3 consists of soils that are well drained or moderately well drained and are loamy or silty throughout. Permeability is moderate or moderately slow. These soils do not have free carbonates in the upper 20 inches.

Group 4 consists of soils that are well drained, moderately well drained, or somewhat poorly drained and have a silty or loamy surface layer and a clayey subsoil. Permeability is slow or very slow.

Group 4C consists of soils that are well drained, moderately well drained, or somewhat poorly drained and have a clayey surface layer and subsoil. Permeability is slow or very slow.

Group 4F consists of soils that are well drained, moderately well drained, or somewhat poorly drained and have a substratum of dense till. Permeability is slow or very slow.

Group 5 consists of soils that are excessively drained to moderately well drained and have a moderate available water capacity. These soils are dominantly fine sandy loam or sandy loam, but some are sandy in the upper part and loamy in the lower part.

Group 6D consists of excessively drained to moderately well drained, loamy soils that have bedrock at a depth of 20 to 40 inches. These soils have a low or moderate available water capacity.

Group 6G consists of excessively drained to moderately well drained soils that are loamy in the upper part and have sand or sand and gravel at a depth of 20 to 40 inches. These soils have a low or moderate available water capacity.

Group 7 consists of excessively drained to well drained soils that are dominantly loamy fine sand or coarser textured and are shallow to sand or to sand and gravel. These soils have a low available water capacity.

Group 8 consists of excessively drained to well drained, loamy soils that have free carbonates within 20 inches of the surface.

Group 9W consists of soils that are somewhat poorly drained, poorly drained, or very poorly drained and are moderately saline (the electrical conductivity is 8 to 16).

Group 10 consists of soils or miscellaneous land types that generally are not suitable for windbreaks. One or more characteristics, such as soil depth, texture, wetness, available water capacity, or slope, limit the planting, survival, or growth of trees and shrubs.

Cropland Management Considerations

(See text for a description of the considerations listed in this table)

Map symbol and soil name	Cropland management considerations
8B:	
Sparta	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Wind erosion
8C:	
Sparta	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
8D:	
Sparta	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Slope Water erosion Wind erosion
35:	
Blue Earth	High organic matter content Lime content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
39A:	
Wadena	Excessive permeability Potential for ground-water contamination
41A:	
Estherville	Excessive permeability Limited available water capacity Potential for ground-water contamination Wind erosion
85:	
Calco	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table Wind erosion
86:	
Canisteo	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
96B:	
Collinwood	Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water erosion
101B:	
Truman	Potential for surface-water contamination Water erosion
102B:	
Clarion	Potential for ground-water contamination Potential for surface-water contamination Water erosion
106C2:	
Lester	Potential for surface-water contamination Previously eroded Water erosion
112:	
Harps	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
113:	
Webster	Potential for ground-water contamination Water table
114:	
Glencoe	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
129:	
Cylinder	Excessive permeability Potential for ground-water contamination Water table
130:	
Nicollet	Potential for ground-water contamination Potential poor tilth and compaction Water table
134:	
Okoboji	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
136:	
Madelia	Potential for ground-water contamination Potential poor tilth and compaction Water table

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
140:	
Spicer	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
143B:	
Chelsea	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Wind erosion
178:	
Granby	Excessive permeability Limited available water capacity Potential for ground-water contamination Water table Wind erosion
181:	
Litchfield	Excessive permeability Potential for ground-water contamination Wind erosion
183:	
Dassel	Excessive permeability Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
197:	
Kingston	Potential for ground-water contamination Potential poor tilth and compaction
211:	
Lura	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
229:	
Waldorf	Potential for ground-water contamination Potential poor tilth and compaction Water table
239:	
Le Sueur	Potential for ground-water contamination Potential poor tilth and compaction
281:	
Darfur	Potential for ground-water contamination Water table
286B:	
Shorewood	Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water erosion

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
311C2:	
Shorewood	Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Previously eroded Water erosion
327A:	
Dickman	Excessive permeability Limited available water capacity Potential for ground-water contamination Wind erosion
327B:	
Dickman	Excessive permeability Limited available water capacity Potential for ground-water contamination Water erosion Wind erosion
399:	
Biscay	Excessive permeability Limited available water capacity Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
415:	
Kanaranzi	Excessive permeability Limited available water capacity Potential for ground-water contamination
423:	
Seaforth	Lime content Potential for ground-water contamination Wind erosion
461B:	
Koronis	Potential for surface-water contamination Water erosion
461C2:	
Koronis	Potential for surface-water contamination Previously eroded Water erosion
511:	
Marcellon	Potential for ground-water contamination Potential for surface-water contamination Water table
523:	
Houghton	High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
525:	
Muskego	High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
539:	
Klossner	High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
548:	
Medo	High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
610:	
Calco	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table Wind erosion
611D:	
Hawick	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Slope Water erosion
612B:	
Wadenill	Potential for surface-water contamination Water erosion
613:	
Grovecity	Potential for ground-water contamination
664:	
Zook	Flooding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
740:	
Hamel	Potential for ground-water contamination Potential for surface-water contamination Water table
Glencoe	Ponding Potential for ground-water contamination Potential for surface-water contamination Water table

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
804B:	
Koronis	Potential for surface-water contamination Water erosion
Sunburg	Potential for surface-water contamination Water erosion Wind erosion
Hawick	Excessive permeability Limited available water capacity Potential for ground-water contamination
804C2:	
Koronis	Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Sunburg	Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Hawick	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Previously eroded Water erosion
804D2:	
Koronis	Potential for surface-water contamination Previously eroded Slope Water erosion Wind erosion
Sunburg	Potential for surface-water contamination Previously eroded Slope Water erosion Wind erosion
Hawick	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Previously eroded Slope Water erosion
804E:	
Koronis	Potential for surface-water contamination Slope Water erosion Wind erosion
Sunburg	Potential for surface-water contamination Slope Water erosion Wind erosion

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
804E:	
Hawick	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Slope Water erosion
805C2:	
Sunburg	Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Wadenill	Potential for surface-water contamination Previously eroded Water erosion
805D2:	
Sunburg	Potential for surface-water contamination Previously eroded Slope Water erosion Wind erosion
Wadenill	Potential for surface-water contamination Previously eroded Slope Water erosion
807D2:	
Koronis	Potential for surface-water contamination Previously eroded Slope Water erosion Wind erosion
Sunburg	Potential for surface-water contamination Previously eroded Slope Water erosion Wind erosion
875B:	
Estherville	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
Hawick	Excessive permeability Limited available water capacity Potential for ground-water contamination Water erosion Wind erosion
875C:	
Hawick	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
875C:	
Estherville	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
887B:	
Clarion	Potential for ground-water contamination Potential for surface-water contamination Water erosion
Swanlake	Lime content Potential for surface-water contamination Water erosion Wind erosion
899:	
Harps	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
Okoboji	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
909C2:	
Bold	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Truman	Potential for surface-water contamination Previously eroded Water erosion
909D2:	
Bold	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Slope Water erosion Wind erosion
Truman	Potential for surface-water contamination Previously eroded Slope Water erosion
920B:	
Clarion	Potential for ground-water contamination Potential for surface-water contamination Water erosion

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
920B:	
Storden	Lime content Limited organic matter content Potential for surface-water contamination Water erosion Wind erosion
Hawick	Excessive permeability Limited available water capacity Potential for ground-water contamination Water erosion
945D2:	
Lester	Potential for surface-water contamination Previously eroded Slope Water erosion
Storden	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Slope Water erosion Wind erosion
945E:	
Lester	Potential for surface-water contamination Slope Water erosion
Storden	Lime content Limited organic matter content Potential for surface-water contamination Slope Water erosion Wind erosion
956:	
Canisteo	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
Glencoe	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
960C2:	
Storden	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Omsrud	Potential for surface-water contamination Previously eroded Water erosion

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
960D2:	
Storden	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Slope Water erosion Wind erosion
Omsrud	Potential for surface-water contamination Previously eroded Slope Water erosion
978:	
Cordova	Potential for ground-water contamination Potential poor tilth and compaction Water table
Rolfe	Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
1015:	
Udipsamments	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Wind erosion
1016:	
Udorthents	Nonsoil material
1030:	
Pits, gravel	Nonsoil material
Udipsamments	Nonsoil material
1080:	
Klossner	High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
Okoboji	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
Glencoe	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
1096:	
Fieldon	Excessive permeability Lime content Potential for ground-water contamination Water table Wind erosion

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
1096:	
Dassel	Excessive permeability Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
1097:	
Mayer	Excessive permeability Lime content Limited available water capacity Potential for ground-water contamination Water table Wind erosion
Biscay	Excessive permeability Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
1098:	
Biscay	Excessive permeability Potential for ground-water contamination Water table
Biscay, depressional	Excessive permeability Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
1099:	
Granby	Excessive permeability Limited available water capacity Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
1100:	
Nicollet	Potential for ground-water contamination Potential poor tilth and compaction Water table
1101:	
Webster	Potential for ground-water contamination Potential poor tilth and compaction Water table
1159B:	
Strout	Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water erosion
Arkton	Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water erosion

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
1161:	
Barry	Potential for ground-water contamination Water table
1162A:	
Kandiyohi	Potential for ground-water contamination Potential poor tilth and compaction Water table
1162B:	
Kandiyohi	Potential for ground-water contamination Potential poor tilth and compaction Water erosion Water table
1163:	
Cohoctah	Flooding Potential for ground-water contamination Water table
1165:	
Lundlake	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
1168:	
Swedegrove	Lime content Potential for ground-water contamination Water table Wind erosion
Lundlake	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
1169:	
Corvuso	Lime content Potential for ground-water contamination Potential poor tilth and compaction Water table Wind erosion
Lura	Ponding Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
1171C:	
Newlondon	Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Previously eroded Surface crusting Water erosion

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
1171C:	
Strout	Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Previously eroded Water erosion
1171D:	
Newlondon	Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Previously eroded Slope Surface crusting Water erosion
Strout	Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Previously eroded Slope Water erosion
1172C:	
Sparta	Excessive permeability Limited available water capacity Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Water erosion Wind erosion
Gardencity	Potential for surface-water contamination Water erosion Wind erosion
1173:	
Muskego	Flooding High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
Klossner	Flooding High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
1174:	
Danielson	Potential for ground-water contamination Potential poor tilth and compaction Water table

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
1175:	
Swedegrove	Lime content Potential for ground-water contamination Water table Wind erosion
1176:	
Litchfield	Excessive permeability Limited available water capacity Potential for ground-water contamination Wind erosion
1177C:	
Gardencity	Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Bold	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
1178:	
Uniongrove	Potential for ground-water contamination Water table
1183:	
Crowriver	Lime content Potential for ground-water contamination Water table Wind erosion
1184:	
Corvuso	Lime content Limited organic matter content Potential for ground-water contamination Potential poor tilth and compaction Surface crusting Water table Wind erosion
1185:	
Gardencity	Potential for ground-water contamination Wind erosion
1186:	
Forestcity	Potential for ground-water contamination Water table Wind erosion
Lundlake	Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
1192:	
Crowriver	Lime content Potential for ground-water contamination Water table Wind erosion

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
1192:	
Lundlake	Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
1193:	
Cosmos	Potential for ground-water contamination Potential poor tilth and compaction Water table
1197:	
Cohoctah	Flooding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
1198B:	
Rohrbeck	Excessive permeability Limited organic matter content Potential for ground-water contamination Potential for surface-water contamination Wind erosion
Koronis	Potential for surface-water contamination Water erosion Wind erosion
1199:	
Klossner	High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
Lundlake	Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
1203:	
Muskego	High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
Blue Earth	High organic matter content Lime content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
Houghton	High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
1204B:	
Reedslake	Potential for ground-water contamination Potential for surface-water contamination Water erosion
1213C:	
Cokato	Potential for surface-water contamination Previously eroded Water erosion
Storden	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
1220C:	
Cokato	Potential for surface-water contamination Previously eroded Water erosion
Storden	Lime content Limited organic matter content Potential for surface-water contamination Previously eroded Water erosion Wind erosion
Hawick	Excessive permeability Limited available water capacity Potential for ground-water contamination Potential for surface-water contamination Previously eroded Water erosion
1356:	
Water, miscellaneous	Nonsoil material
1362B:	
Angus	Potential for ground-water contamination Potential for surface-water contamination Water erosion
1383A:	
Shorewood	Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
1384:	
Minneopa	Excessive permeability Limited available water capacity Potential for ground-water contamination
1385:	
Havelock	Flooding Lime content Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion

Cropland Management Considerations--Continued

Map symbol and soil name	Cropland management considerations
1387A:	
Collinwood	Potential for ground-water contamination Potential for surface-water contamination Potential poor tilth and compaction Water table
1391B:	
Wadenill	Potential for surface-water contamination Water erosion
Sunburg	Potential for surface-water contamination Water erosion Wind erosion
1406:	
Medo	High organic matter content Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
Dassel	Excessive permeability Ponding Potential for ground-water contamination Potential for surface-water contamination Water table Wind erosion
Biscay	Excessive permeability Ponding Potential for ground-water contamination Potential for surface-water contamination Water table
1801B:	
Gardencity	Potential for surface-water contamination Water erosion Wind erosion

Land Capability and Yields per Acre of Crops and Pasture

(Yields are those that can be expected under a high level of management. They are for nonirrigated areas. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Map symbol and soil name	Land capability	Corn	Soybeans	Oats	Spring wheat	Bromegrass-alfalfa	Bromegrass-alfalfa hay
		Bu	Bu	Bu	Bu	AUM*	Tons
8B--------------- Sparta	4s	69	23	65	39	3.0	2
8C--------------- Sparta	6s	58	20	52	31	2.3	2
8D--------------- Sparta	7s	55	18	49	29	2.2	2
35--------------- Blue Earth	3w	107	31	74	44	4.0	3
39A-------------- Wadena	2s	112	34	79	48	4.3	3
41A-------------- Estherville	3s	65	22	55	33	2.5	2
85--------------- Calco	2w	123	36	74	44	4.6	4
86--------------- Canisteo	2w	138	40	83	50	5.0	4
96B-------------- Collinwood	2e	140	50	86	51	5.3	4
101B------------- Truman	2e	147	48	89	53	6.0	5
102B------------- Clarion	2e	145	45	89	53	6.0	5
106C2------------ Lester	3e	126	38	76	47	5.3	4
112-------------- Harps	2w	134	38	80	48	4.9	4
113-------------- Webster	2w	144	47	86	52	5.2	4
114-------------- Glencoe	3w	127	44	80	48	4.3	3
129-------------- Cylinder	2s	115	38	78	47	3.9	3
130-------------- Nicollet	1	150	50	88	52	5.7	4
134-------------- Okoboji	3w	133	41	80	48	4.3	3
136-------------- Madelia	2w	144	48	86	52	5.2	4

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Oats	Spring wheat	Bromegrass-alfalfa	Bromegrass-alfalfa hay
		Bu	Bu	Bu	Bu	AUM*	Tons
140 Spicer	2w	140	45	81	48	4.7	4
143B Chelsea	4s	81	25	68	41	3.3	2
178 Granby	4w	97	30	74	44	3.4	3
181 Litchfield	3s	104	32	79	47	4.2	3
183 Dassel	3w	115	36	76	46	3.8	3
197 Kingston	1	153	52	90	54	5.6	5
211 Lura	3w	125	36	76	46	4.0	3
229 Waldorf	2w	144	47	86	52	5.2	4
239 Le Sueur	1	150	51	90	54	6.7	5
281 Darfur	2w	135	42	84	51	4.9	4
286B Shorewood	2e	139	43	87	52	5.6	4
311C2 Shorewood	3e	129	41	75	45	4.7	4
327A Dickman	3s	74	23	65	39	3.0	2
327B Dickman	3e	70	21	62	37	2.7	2
399 Biscay	3w	84	26	64	38	2.7	2
415 Kanaranzi	3s	74	23	65	39	3.5	2
423 Seaforth	2s	145	46	86	50	5.2	4
461B Koronis	2e	130	40	79	47	5.2	4
461C2 Koronis	3e	115	34	72	43	4.6	4
511 Marcellon	1	133	41	86	52	5.1	4

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Oats	Spring wheat	Bromegrass-alfalfa	Bromegrass-alfalfa hay
		Bu	Bu	Bu	Bu	AUM*	Tons
523-------------- Houghton	3w	105	34	76	46	4.1	3
525-------------- Muskego	4w	105	34	76	46	4.2	3
539-------------- Klossner	3w	105	34	76	46	4.2	3
548-------------- Medo	3w	105	34	76	46	4.2	3
610-------------- Calco	5w	---	---	---	---	---	---
611D------------- Hawick	7s	39	13	35	20	1.4	1
612B------------- Wadenill	2e	135	42	83	49	5.5	4
613-------------- Grovecity	1	142	46	85	54	6.0	5
664-------------- Zook	2w	119	37	72	43	4.3	3
740--------------		138	44	82	50	5.1	4
Hamel-----------	2w						
Glencoe---------	3w						
804B-------------		125	39	82	48	5.2	4
Koronis---------	2e						
Sunburg---------	2e						
Hawick----------	4s						
804C2------------		112	35	74	44	4.6	4
Koronis---------	3e						
Sunburg---------	3e						
Hawick----------	4s						
804D2------------		102	30	67	40	4.2	3
Koronis---------	4e						
Sunburg---------	4e						
Hawick----------	6s						
804E-------------		---	---	---	---	3.6	3
Koronis---------	6e						
Sunburg---------	7e						
Hawick----------	7s						

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Oats	Spring wheat	Bromegrass-alfalfa	Bromegrass-alfalfa hay
		Bu	Bu	Bu	Bu	AUM*	Tons
805C2 Sunburg-Wadenill	3e	118	36	74	44	4.8	4
805D2 Sunburg-Wadenill	4e	98	31	63	37	4.0	3
807D2 Koronis-Sunburg	4e	108	31	57	34	4.2	3
875B		60	17	50	30	2.1	2
Estherville	3s						
Hawick	4s						
875C Hawick-Estherville	4s	49	15	47	28	2.0	2
887B Clarion-Swanlake	2e	144	43	88	53	6.0	5
899		133	39	80	48	4.8	4
Harps	2w						
Okoboji	3w						
909C2 Bold-Truman	3e	127	41	74	44	4.9	4
909D2		108	35	58	37	4.2	3
Bold	6e						
Truman	4e						
920B		130	40	80	48	5.2	4
Clarion	2e						
Storden	2e						
Hawick	4s						
945D2 Lester-Storden	4e	108	34	58	35	4.4	3
945E Lester-Storden	7e	---	---	---	---	4.0	3
956		137	41	82	49	4.8	4
Canisteo	2w						
Glencoe	3w						
960C2 Storden-Omsrud	3e	125	40	73	44	4.5	4
960D2 Storden-Omsrud	4e	108	35	58	37	4.2	3

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Oats	Spring wheat	Bromegrass-alfalfa	Bromegrass-alfalfa hay
		Bu	Bu	Bu	Bu	AUM*	Tons
978		142	44	85	51	5.1	4
Cordova	2w						
Rolfe	3w						
1015 Udipsamments	8s	---	---	---	---	---	---
1016 Udorthents	6s	---	---	---	---	---	---
1030: Pits, gravel.							
Udipsamments	8s	---	---	---	---	---	---
1080 Klossner, Okoboji, and Glencoe	8w	---	---	---	---	---	---
1096		113	33	77	46	4.0	3
Fieldon	2w						
Dassel	3w						
1097		97	29	73	44	3.5	3
Mayer	2w						
Biscay	3w						
1098		107	33	78	47	3.9	3
Biscay	2w						
Biscay, depressional	3w						
1099 Granby	5w	---	---	---	---	---	---
1100 Nicollet	1	148	46	89	53	5.9	4
1101 Webster	2w	144	44	86	52	5.2	4
1159B Strout-Arkton	2e	140	41	82	49	5.2	4
1161 Barry	2w	135	42	84	49	4.9	4
1162A Kandiyohi	2w	143	44	87	50	5.1	4
1162B Kandiyohi	2e	140	43	85	49	4.9	4
1163 Cohoctah	5w	---	---	---	---	---	---

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Oats	Spring wheat	Bromegrass-alfalfa	Bromegrass-alfalfa hay
		Bu	Bu	Bu	Bu	AUM*	Tons
1165 Lundlake	3w	122	34	78	46	4.4	3
1168		125	37	83	50	4.8	4
Swedegrove	2w						
Lundlake	3w						
1169		130	37	78	46	4.7	4
Corvuso	2w						
Lura	3w						
1171C Newlondon-Strout	3e	118	36	77	46	4.8	4
1171D Newlondon-Strout	4e	102	31	58	35	4.2	3
1172C		80	27	66	40	3.5	3
Sparta	6s						
Gardencity	3e						
1173 Muskego and Klossner	8w	---	---	---	---	---	---
1174 Danielson	2w	142	45	85	50	5.2	4
1175 Swedegrove	2w	128	38	82	49	4.7	4
1176 Litchfield	2s	96	30	77	46	3.9	3
1177C Gardencity-Bold	3e	121	37	76	46	4.9	4
1178 Uniongrove	2w	128	40	82	50	4.7	4
1183 Crowriver	2w	124	36	80	48	4.7	4
1184 Corvuso	2w	132	38	80	48	4.9	4
1185 Gardencity	1	129	38	82	49	4.7	4
1186		134	40	80	48	5.1	4
Forestcity	2w						
Lundlake	3w						

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Oats	Spring wheat	Bromegrass-alfalfa	Bromegrass-alfalfa hay
		Bu	Bu	Bu	Bu	AUM*	Tons
1192		123	35	80	47	4.7	4
Crowriver	2w						
Lundlake	3w						
1193 Cosmos	2w	135	42	83	50	4.9	4
1197 Cohoctah	2w	105	33	68	38	3.9	3
1198B		110	36	71	43	4.4	3
Rohrbeck	3s						
Koronis	2e						
1199 Klossner and Lundlake	8w	---	---	---	---	---	---
1203 Muskego, Blue Earth, and Houghton	8w	---	---	---	---	---	---
1204B Reedslake	2e	145	45	89	53	6.0	5
1213C Cokato-Storden	3e	129	40	77	46	5.2	4
1220C		118	36	73	44	4.8	4
Cokato	3e						
Storden	3e						
Hawick	4s						
1362B Angus	2e	141	44	89	53	6.0	5
1383A Shorewood	2w	145	47	88	53	5.6	4
1384 Minneopa	3s	74	23	65	39	3.0	2
1385 Havelock	5w	---	---	---	---	---	---
1387A Collinwood	2w	145	51	86	52	5.3	4
1391B Wadenill-Sunburg	2e	133	41	83	48	5.3	4
1406 Medo, Dassel, and Biscay	6w	---	---	---	---	---	---

See footnote at end of table.

Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Oats	Spring wheat	Bromegrass-alfalfa	Bromegrass-alfalfa hay
		Bu	Bu	Bu	Bu	AUM*	Tons
1801B------------ Gardencity	2e	137	42	88	53	5.6	4

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

Prime Farmland

Map symbol	Soil name
39A	Wadena loam, 0 to 2 percent slopes
85	Calco silty clay loam, 0 to 2 percent slopes, occasionally flooded (where drained)
86	Canisteo clay loam, moderately fine substratum, 0 to 2 percent slopes (where drained)
96B	Collinwood silty clay loam, 3 to 6 percent slopes
101B	Truman silt loam, 2 to 6 percent slopes
102B	Clarion loam, moderately fine substratum, 2 to 5 percent slopes
112	Harps clay loam, 0 to 2 percent slopes (where drained)
113	Webster clay loam, 0 to 2 percent slopes (where drained)
114	Glencoe clay loam, depressional, 0 to 1 percent slopes (where drained)
129	Cylinder loam, 0 to 1 percent slopes
130	Nicollet clay loam, 1 to 3 percent slopes
134	Okoboji silty clay loam, depressional, 0 to 1 percent slopes (where drained)
136	Madelia silty clay loam, 0 to 2 percent slopes (where drained)
140	Spicer silty clay loam, 0 to 2 percent slopes (where drained)
197	Kingston silty clay loam, 1 to 3 percent slopes
211	Lura silty clay, depressional, 0 to 1 percent slopes (where drained)
229	Waldorf silty clay loam, 0 to 2 percent slopes (where drained)
239	Le Sueur clay loam, 1 to 3 percent slopes
281	Darfur loam, 0 to 2 percent slopes (where drained)
286B	Shorewood silty clay loam, 3 to 6 percent slopes
423	Seaforth loam, 1 to 3 percent slopes
461B	Koronis loam, 2 to 6 percent slopes
511	Marcellon loam, 0 to 3 percent slopes
612B	Wadenill loam, 2 to 6 percent slopes
613	Grovecity loam, 1 to 3 percent slopes
664	Zook silty clay loam, 0 to 2 percent slopes, occasionally flooded (where drained)
740	Hamel-Glencoe, depressional, complex, 0 to 3 percent slopes (where drained)
804B	Koronis-Sunburg-Hawick complex, 2 to 6 percent slopes
887B	Clarion-Swanlake complex, 2 to 6 percent slopes
899	Harps-Okoboji, depressional, complex, 0 to 2 percent slopes (where drained)
956	Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes (where drained)
978	Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes (where drained)
1100	Nicollet silty clay loam, 1 to 3 percent slopes
1101	Webster silty clay loam, moderately fine substratum, 0 to 2 percent slopes (where drained)
1159B	Strout-Arkton complex, 2 to 6 percent slopes
1161	Barry loam, 0 to 2 percent slopes (where drained)
1162A	Kandiyohi clay, 0 to 2 percent slopes (where drained)
1162B	Kandiyohi clay, 2 to 5 percent slopes
1165	Lundlake silty clay loam, depressional, 0 to 1 percent slopes (where drained)
1168	Swedegrove-Lundlake, depressional, complex, 0 to 2 percent slopes (where drained)
1169	Corvuso-Lura, depressional, complex, 0 to 2 percent slopes (where drained)
1174	Danielson clay loam, 1 to 3 percent slopes (where drained)
1175	Swedegrove loam, 0 to 2 percent slopes (where drained)
1178	Uniongrove loam, 0 to 2 percent slopes (where drained)
1183	Crowriver loam, 0 to 2 percent slopes (where drained)
1184	Corvuso silty clay loam, 0 to 2 percent slopes (where drained)
1185	Gardencity fine sandy loam, moderately wet, 0 to 2 percent slopes
1186	Forestcity-Lundlake, depressional, complex, 0 to 3 percent slopes (where drained)
1192	Crowriver-Lundlake, depressional, complex, 0 to 2 percent slopes (where drained)
1193	Cosmos silty clay, 0 to 2 percent slopes (where drained)
1204B	Reedslake loam, 2 to 5 percent slopes
1362B	Angus loam, 2 to 5 percent slopes
1383A	Shorewood silty clay loam, moderately wet, 0 to 3 percent slopes
1387A	Collinwood silty clay loam, moderately wet, 0 to 3 percent slopes
1391B	Wadenill-Sunburg complex, 2 to 6 percent slopes
1801B	Gardencity very fine sandy loam, 2 to 6 percent slopes

Windbreaks and Environmental Plantings

(Absence of an entry indicates that trees generally do not grow to the given height)

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
8B:					
Sparta----------	Siberian peashrub	Eastern redcedar, Black Hills spruce, blue spruce, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Silver maple, green ash, Norway spruce, white spruce, Austrian pine, red pine, Siberian elm.	Eastern white pine, Scotch pine, eastern cottonwood.	---
8C, 8D:					
Sparta----------	Siberian peashrub	Eastern redcedar, Black Hills spruce, blue spruce, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Silver maple, green ash, Norway spruce, white spruce, Austrian pine, red pine.	Eastern white pine, Scotch pine, eastern cottonwood.	---
35:					
Blue Earth------	---	Redosier dogwood	Tall purple willow	White willow, golden willow.	Eastern cottonwood.
39A:					
Wadena----------	Siberian peashrub, lilac.	Hackberry, eastern redcedar, American plum, chokecherry, silver buffaloberry, northern whitecedar.	Norway spruce, white spruce, Black Hills spruce, blue spruce, eastern white pine, bur oak.	Silver maple, green ash.	Eastern cottonwood.
41A:					
Estherville-----	Siberian peashrub	Eastern redcedar, Black Hills spruce, blue spruce, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Silver maple, green ash, Norway spruce, white spruce, Austrian pine, red pine.	Eastern white pine, Scotch pine, eastern cottonwood.	---
85:					
Calco-----------	---	American plum, lilac, northern whitecedar.	Hackberry, eastern redcedar, Black Hills spruce.	Green ash, golden willow.	Silver maple, eastern cottonwood.
86:					
Canisteo--------	Redosier dogwood	American plum, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Eastern redcedar, white spruce, Black Hills spruce, blue spruce.	Green ash, golden willow, black willow.	Eastern cottonwood, Siouxland cottonwood.

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
96B:					
Collinwood	---	Siberian peashrub, cotoneaster, eastern redcedar, lilac, northern whitecedar.	Amur maple, hackberry, Norway spruce, Austrian pine, bur oak.	Green ash, eastern white pine.	---
101B:					
Truman	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, sugar maple, hackberry, eastern redcedar, Norway spruce, bur oak, northern whitecedar.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
102B:					
Clarion	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, Black Hills spruce, bur oak.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
106C2:					
Lester	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, Black Hills spruce, bur oak.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
112:					
Harps	---	Lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce, Black Hills spruce.	Green ash, honeylocust, golden willow.	Eastern cottonwood.
113:					
Webster	---	Redosier dogwood, cotoneaster, eastern redcedar, chokecherry, silver buffaloberry.	Hackberry, white spruce, Black Hills spruce, blue spruce, Scotch pine, American plum, tall purple willow, northern whitecedar.	Green ash, jack pine, eastern white pine, golden willow.	Silver maple, eastern cottonwood, Siouxland cottonwood.
114:					
Glencoe	---	Redosier dogwood	Black ash, green ash, black spruce, northern whitecedar.	Golden willow, black willow.	Eastern cottonwood.

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
129:					
Cylinder	---	Redosier dogwood, eastern redcedar, blue spruce, lilac.	Amur maple, white spruce, northern whitecedar.	Hackberry, green ash, Austrian pine, eastern white pine.	Silver maple.
130:					
Nicollet	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, black walnut, eastern redcedar, Norway spruce, jack pine, white spruce, Black Hills spruce.	Hackberry, green ash, Austrian pine, eastern white pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.
134:					
Okoboji	---	Redosier dogwood	Black ash, green ash, black spruce, northern whitecedar.	Golden willow, black willow.	Eastern cottonwood.
136:					
Madelia	---	Redosier dogwood, cotoneaster, eastern redcedar, chokecherry, silver buffaloberry.	Amur maple, hackberry, white spruce, Black Hills spruce, blue spruce, Scotch pine, American plum, northern whitecedar.	Green ash, jack pine, eastern white pine, golden willow.	Silver maple, eastern cottonwood, Siouxland cottonwood.
140:					
Spicer	---	Lilac, northern whitecedar.	Hackberry, eastern redcedar, Norway spruce, Black Hills spruce, bur oak.	Green ash, honeylocust, golden willow.	Silver maple, eastern cottonwood.
143B:					
Chelsea	Siberian peashrub, lilac.	Eastern redcedar, Black Hills spruce.	Green ash, Norway spruce, Austrian pine, red pine.	Eastern white pine	---
178:					
Granby	---	American plum, northern whitecedar.	Eastern cottonwood	Silver maple, golden willow, black willow.	---
181:					
Litchfield	---	Redosier dogwood, American plum, lilac.	Amur maple, blue spruce, northern whitecedar.	Hackberry, green ash, Austrian pine, eastern white pine.	Silver maple.
183:					
Dassel	---	Redosier dogwood, American plum.	Amur maple, hackberry, northern whitecedar.	Green ash, golden willow, black willow.	Silver maple, eastern cottonwood.

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
197:					
Kingston	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, black walnut, eastern redcedar, Norway spruce, jack pine, white spruce, Black Hills spruce.	Hackberry, green ash, Austrian pine, eastern white pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.
211:					
Lura	---	Redosier dogwood	Black ash, green ash, black spruce, northern whitecedar.	White willow, golden willow, black willow.	Eastern cottonwood.
229:					
Waldorf	---	Redosier dogwood, lilac.	Amur maple, hackberry, white spruce, American plum, northern whitecedar.	Green ash, golden willow, black willow.	Silver maple, eastern cottonwood.
239:					
Le Sueur	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, black walnut, eastern redcedar, Norway spruce, jack pine, white spruce, Black Hills spruce.	Hackberry, green ash, Austrian pine, eastern white pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.
281:					
Darfur	---	Redosier dogwood, cotoneaster, eastern redcedar, American plum, chokecherry, silver buffaloberry.	Amur maple, hackberry, white spruce, Black Hills spruce, blue spruce, Scotch pine, northern whitecedar.	Green ash, jack pine, eastern white pine, golden willow.	Silver maple, eastern cottonwood, Siouxland cottonwood.
286B:					
Shorewood	---	Siberian peashrub, eastern redcedar, lilac.	Hackberry, Norway spruce, white spruce, Black Hills spruce, Austrian pine, bur oak.	Sugar maple, green ash, eastern white pine.	---
311C2:					
Shorewood	Siberian peashrub, cotoneaster, lilac.	Eastern redcedar	Hackberry, green ash, Norway spruce, Black Hills spruce, Austrian pine.	Siberian elm	---

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
327A:					
Dickman----------	Siberian peashrub	Black Hills spruce, blue spruce, chokecherry, silver buffaloberry, lilac.	Silver maple, green ash, eastern redcedar, Norway spruce, jack pine, white spruce, Austrian pine.	Red pine, eastern white pine, eastern cottonwood.	---
327B:					
Dickman----------	Siberian peashrub	Black Hills spruce, blue spruce, silver buffaloberry, lilac.	Silver maple, green ash, eastern redcedar, Norway spruce, jack pine, white spruce, Austrian pine.	Red pine, eastern white pine, eastern cottonwood.	---
399:					
Biscay-----------	---	Redosier dogwood	Black ash, northern whitecedar.	Golden willow, black willow.	Eastern cottonwood.
415:					
Kanaranzi--------	Siberian peashrub, lilac.	Eastern redcedar, American plum, chokecherry, silver buffaloberry, northern whitecedar.	White spruce, Black Hills spruce, blue spruce, bur oak.	Silver maple, green ash.	Eastern cottonwood.
423:					
Seaforth---------	---	Siberian peashrub, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, black walnut, eastern redcedar, Norway spruce, Scotch pine, bur oak.	Green ash, thornless honeylocust, golden willow.	Eastern cottonwood, Siouxland cottonwood.
461B, 461C2:					
Koronis----------	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, white spruce, Black Hills spruce, bur oak.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
511:					
Marcellon--------	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, black walnut, eastern redcedar, Norway spruce, jack pine, white spruce, Black Hills spruce.	Hackberry, green ash, Austrian pine, eastern white pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
523: Houghton	---	Siberian peashrub, redosier dogwood.	Black ash, green ash, tamarack, tall purple willow.	Black willow	---
525: Muskego	---	Siberian peashrub, redosier dogwood.	Black ash, green ash, tamarack, tall purple willow.	Black willow	---
539: Klossner	---	Siberian peashrub, redosier dogwood.	Black ash, green ash, tamarack, tall purple willow.	Black willow	---
548: Medo	---	Siberian peashrub, redosier dogwood.	Black ash, green ash, tamarack, tall purple willow.	Black willow	---
610: Calco	---	Redosier dogwood, lilac, northern whitecedar.	Eastern redcedar	Green ash, honeylocust, golden willow, black willow.	Eastern cottonwood, Siouxland cottonwood.
611D: Hawick	Siberian peashrub	Honeysuckle, blue spruce, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Silver maple, green ash, thornless honeylocust, eastern redcedar, Norway spruce, jack pine, Austrian pine.	Red pine, eastern white pine, Scotch pine, eastern cottonwood.	---
612B: Wadenill	---	Siberian peashrub, cotoneaster, blue spruce, chokecherry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce.	Silver maple, green ash, eastern white pine.	---
613: Grovecity	---	Siberian peashrub, redosier dogwood, cotoneaster, blue spruce, chokecherry, silver buffaloberry, lilac.	Amur maple, black walnut, eastern redcedar, Norway spruce, jack pine, white spruce.	Hackberry, green ash, Austrian pine, eastern white pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
664: Zook	---	Redosier dogwood, cotoneaster, eastern redcedar, chokecherry, silver buffaloberry.	White spruce, Black Hills spruce, blue spruce, Scotch pine, American plum, northern whitecedar.	Green ash, jack pine, eastern white pine, golden willow.	Silver maple, eastern cottonwood, Siouxland cottonwood.
740: Hamel	---	Redosier dogwood, cotoneaster, eastern redcedar, American plum, chokecherry, silver buffaloberry.	Amur maple, hackberry, white spruce, Black Hills spruce, blue spruce, Scotch pine, northern whitecedar.	Green ash, jack pine, eastern white pine, golden willow, black willow.	Silver maple, eastern cottonwood, Siouxland cottonwood.
Glencoe	---	Redosier dogwood	Black ash, green ash, black spruce, northern whitecedar.	Golden willow, black willow.	Eastern cottonwood.
804B, 804C2: Koronis	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, white spruce, Black Hills spruce.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
Sunburg	American plum, late lilac, lilac.	Siberian peashrub, hackberry, eastern redcedar, honeysuckle, Black Hills spruce.	Green ash, thornless honeylocust.	---	---
Hawick	Siberian peashrub	Honeysuckle, late lilac.	Green ash, eastern redcedar, Norway spruce, Austrian pine.	Red pine, eastern white pine.	---
804D2: Koronis	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, white spruce, Black Hills spruce.	Green ash, black walnut, eastern white pine.	Silver maple, Siouxland cottonwood.
Sunburg	American plum, late lilac, lilac.	Siberian peashrub, hackberry, eastern redcedar, honeysuckle, Black Hills spruce.	Green ash, thornless honeylocust.	---	---

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
804D2:					
Hawick	Siberian peashrub	Honeysuckle, late lilac.	Green ash, thornless honeylocust, eastern redcedar, Norway spruce, Austrian pine.	Red pine, eastern white pine.	---
804E:					
Koronis	---	Siberian peashrub, blue spruce, American plum, chokecherry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, Black Hills spruce.	Green ash, eastern white pine.	---
Sunburg	American plum, late lilac, lilac.	Siberian peashrub, hackberry, eastern redcedar, honeysuckle, Black Hills spruce.	Green ash, thornless honeylocust.	---	---
Hawick	Siberian peashrub	Honeysuckle, late lilac.	Green ash, thornless honeylocust, eastern redcedar, Norway spruce, Austrian pine.	Red pine, eastern white pine.	---
805C2, 805D2:					
Sunburg	American plum, late lilac, lilac.	Siberian peashrub, hackberry, eastern redcedar, honeysuckle, Black Hills spruce.	Green ash, thornless honeylocust.	---	---
Wadenill	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, white spruce, Black Hills spruce.	Green ash, black walnut, eastern white pine.	Silver maple, Siouxland cottonwood.
807D2:					
Koronis	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, white spruce, Black Hills spruce.	Green ash, black walnut, eastern white pine.	Silver maple, Siouxland cottonwood.
Sunburg	American plum, late lilac, lilac.	Siberian peashrub, hackberry, eastern redcedar, honeysuckle, Black Hills spruce.	Green ash, thornless honeylocust.	---	---

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
875B:					
Estherville	Siberian peashrub	Eastern redcedar, Black Hills spruce, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Silver maple, green ash, honeylocust, Norway spruce, jack pine, white spruce, Austrian pine.	Eastern white pine, Scotch pine, eastern cottonwood, Siberian elm.	---
Hawick	Siberian peashrub	Honeysuckle, late lilac.	Green ash, thornless honeylocust, eastern redcedar, jack pine, Austrian pine.	Red pine, eastern white pine.	---
875C:					
Hawick	Siberian peashrub	Honeysuckle, chokecherry, silver buffaloberry, late lilac, northern whitecedar.	Silver maple, green ash, thornless honeylocust, eastern redcedar, Norway spruce, jack pine, white spruce, Austrian pine.	Red pine, eastern white pine, eastern cottonwood, Siberian elm.	---
Estherville	Siberian peashrub	Eastern redcedar, lilac.	Green ash, honeylocust, jack pine, Austrian pine, red pine.	Eastern white pine	---
887B:					
Clarion	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, white spruce, Black Hills spruce.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
Swanlake	American plum	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
899:					
Harps	Redosier dogwood	Chokecherry, silver buffaloberry, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce, Black Hills spruce, blue spruce.	Green ash, honeylocust, golden willow, black willow.	Eastern cottonwood, Siouxland cottonwood.
Okoboji	---	Redosier dogwood	Black ash, green ash, black spruce.	White willow, golden willow, black willow.	Eastern cottonwood.

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
909C2:					
Bold	American plum	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
Truman	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, Black Hills spruce, bur oak.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
909D2:					
Bold	American plum	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	Jack pine	---
Truman	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, white spruce, Black Hills spruce, bur oak.	Green ash, black walnut, eastern white pine.	Silver maple, Siouxland cottonwood.
920B:					
Clarion	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, bur oak.	Green ash, black walnut, eastern white pine.	Silver maple, Siouxland cottonwood.
Storden	American plum	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
Hawick	Siberian peashrub	Honeysuckle, late lilac.	Green ash, thornless honeylocust, eastern redcedar, jack pine, Austrian pine.	Red pine, eastern white pine.	---
945D2:					
Lester	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, white spruce, Black Hills spruce, bur oak.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
945D2:					
Storden	American plum	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
945E:					
Lester	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, Black Hills spruce.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple.
Storden	American plum	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
956:					
Canisteo	Redosier dogwood	Chokecherry, silver buffaloberry, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce, Black Hills spruce, blue spruce.	Green ash, honeylocust, golden willow, black willow.	Eastern cottonwood, Siouxland cottonwood.
Glencoe	---	Redosier dogwood	Black ash, green ash, black spruce, northern whitecedar.	White willow, golden willow, black willow.	Silver maple, eastern cottonwood.
960C2, 960D2:					
Storden	American plum	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Sugar maple, green ash, honeylocust.	---	---
Omsrud	---	Siberian peashrub, redosier dogwood, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, white spruce, Black Hills spruce.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
978:					
Cordova	---	Redosier dogwood, cotoneaster, eastern redcedar, American plum, chokecherry, silver buffaloberry.	Amur maple, hackberry, white spruce, Black Hills spruce, blue spruce, Scotch pine, northern whitecedar.	Green ash, jack pine, eastern white pine, golden willow.	Silver maple, eastern cottonwood, Siouxland cottonwood.
Rolfe	---	Redosier dogwood, American plum.	Hackberry, white spruce, northern whitecedar.	Green ash, golden willow, black willow.	Silver maple, eastern cottonwood.

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1096:					
Fieldon	Redosier dogwood	American plum, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Eastern redcedar, white spruce.	Green ash, golden willow, black willow.	Eastern cottonwood, Siouxland cottonwood.
Dassel	---	Redosier dogwood, American plum.	Amur maple, hackberry, white spruce, northern whitecedar.	Green ash, golden willow, black willow.	Silver maple, eastern cottonwood.
1097:					
Mayer	Redosier dogwood	American plum, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce, bur oak.	Green ash, golden willow, black willow.	Eastern cottonwood, Siouxland cottonwood.
Biscay	---	Redosier dogwood	Black ash	White willow, golden willow, black willow.	Eastern cottonwood.
1098:					
Biscay	---	Redosier dogwood, cotoneaster, American plum.	Amur maple, hackberry, white spruce, tall purple willow, northern whitecedar.	Green ash, golden willow.	Silver maple, eastern cottonwood.
Biscay, depressional	---	Redosier dogwood	Black ash	White willow, golden willow, black willow.	Eastern cottonwood.
1100:					
Nicollet	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, black walnut, eastern redcedar, Norway spruce, jack pine, white spruce, Black Hills spruce.	Hackberry, green ash, Austrian pine, eastern white pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.
1101:					
Webster	---	Redosier dogwood, cotoneaster, eastern redcedar, American plum, chokecherry, silver buffaloberry.	Hackberry, white spruce, Black Hills spruce, blue spruce, Scotch pine, northern whitecedar.	Green ash, jack pine, eastern white pine, golden willow.	Silver maple, eastern cottonwood, Siouxland cottonwood.

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
1159B:					
Strout	---	Siberian peashrub, redosier dogwood, cotoneaster, American plum, chokecherry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce.	Green ash, eastern white pine.	---
Arkton	---	Siberian peashrub, lilac.	Hackberry, eastern redcedar, white spruce, bur oak.	Green ash, golden willow.	Honeylocust, eastern cottonwood.
1161:					
Barry	---	Redosier dogwood, cotoneaster, eastern redcedar, American plum, chokecherry, silver buffaloberry.	Amur maple, hackberry, white spruce, Black Hills spruce, blue spruce, Scotch pine, northern whitecedar.	Green ash, jack pine, eastern white pine, golden willow.	Silver maple, eastern cottonwood.
1162A, 1162B:					
Kandiyohi	Lilac	Siberian peashrub, eastern redcedar.	Hackberry, green ash, honeylocust, Black Hills spruce, American plum.	---	---
1163:					
Cohoctah	---	Redosier dogwood, American plum.	Amur maple, hackberry, white spruce, tall purple willow, northern whitecedar.	Green ash, golden willow.	Silver maple, eastern cottonwood.
1165:					
Lundlake	---	Redosier dogwood	Black ash, green ash, black spruce, northern whitecedar.	Eastern cottonwood, golden willow, black willow.	---
1168:					
Swedegrove	Redosier dogwood	American plum, chokecherry, silver buffaloberry, lilac.	Hackberry, eastern redcedar, white spruce, blue spruce.	Green ash, golden willow, black willow.	Eastern cottonwood, Siouxland cottonwood.
Lundlake	---	Redosier dogwood	Black ash, green ash, black spruce, northern whitecedar.	Eastern cottonwood, golden willow, black willow.	---
1169:					
Corvuso	Redosier dogwood	Cotoneaster, chokecherry, silver buffaloberry, lilac.	Hackberry, American plum, northern whitecedar.	Green ash, golden willow, black willow.	Eastern cottonwood.

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
1169:					
Lura	---	Redosier dogwood	Black ash, green ash, black spruce, northern whitecedar.	White willow, golden willow, black willow.	Eastern cottonwood.
1171C, 1171D:					
Newlondon	---	Siberian peashrub, chokecherry, late lilac, lilac.	Hackberry, eastern redcedar, Black Hills spruce, bur oak.	Green ash, golden willow.	Honeylocust, eastern cottonwood.
Strout	---	Siberian peashrub, redosier dogwood, American plum, lilac.	Amur maple, sugar maple, hackberry, eastern redcedar, Norway spruce, blue spruce.	Green ash, eastern white pine.	---
1172C:					
Sparta	Siberian peashrub	Eastern redcedar, Black Hills spruce, blue spruce, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Silver maple, green ash, Norway spruce, white spruce, Austrian pine, red pine.	Eastern white pine, Scotch pine, eastern cottonwood.	---
Gardencity	---	Siberian peashrub, eastern redcedar, Siberian crabapple, common chokecherry, lilac.	Hackberry, Norway spruce, red pine.	Green ash, thornless honeylocust, eastern white pine.	---
1174:					
Danielson	---	Redosier dogwood, eastern redcedar, chokecherry.	Amur maple, white spruce, Black Hills spruce, blue spruce, Scotch pine, American plum, northern whitecedar.	Green ash, jack pine, eastern white pine, golden willow, black willow.	Silver maple, eastern cottonwood, Siouxland cottonwood.
1175:					
Swedegrove	Redosier dogwood	American plum, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Green ash, golden willow, black willow.	Eastern cottonwood, Siouxland cottonwood.
1176:					
Litchfield	Siberian peashrub	Blue spruce, American plum, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Amur maple, silver maple, jack pine, white spruce.	Hackberry, green ash, Austrian pine, eastern white pine, Scotch pine.	---

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1177C:					
Gardencity	---	Siberian peashrub, eastern redcedar, Siberian crabapple, common chokecherry, lilac.	Hackberry, Norway spruce, red pine.	Green ash, thornless honeylocust, eastern white pine.	---
Bold	American plum	Siberian peashrub, hackberry, cotoneaster, eastern redcedar.	Amur maple, green ash.	Eastern white pine	---
1178:					
Uniongrove	---	Redosier dogwood, cotoneaster, eastern redcedar, chokecherry, silver buffaloberry.	Hackberry, white spruce, Black Hills spruce, blue spruce, Scotch pine, American plum, northern whitecedar.	Green ash, jack pine, eastern white pine, golden willow, black willow.	Silver maple, eastern cottonwood, Siouxland cottonwood.
1183:					
Crowriver	Redosier dogwood	American plum, silver buffaloberry, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Green ash, golden willow, black willow.	Eastern cottonwood, Siouxland cottonwood.
1184:					
Corvuso	Redosier dogwood	American plum, chokecherry, silver buffaloberry, lilac, northern whitecedar.	Eastern redcedar, blue spruce.	Green ash, golden willow, black willow.	Eastern cottonwood, Siouxland cottonwood.
1185:					
Gardencity	---	Redosier dogwood, Black Hills spruce, blue spruce, American plum, silver buffaloberry, lilac.	Hackberry, green ash, white spruce, Austrian pine, red pine, eastern white pine, bur oak.	Norway spruce, jack pine.	Silver maple, Siouxland cottonwood.
1186:					
Forestcity	---	Redosier dogwood, cotoneaster, eastern redcedar, chokecherry, silver buffaloberry.	Amur maple, hackberry, white spruce, Black Hills spruce, blue spruce, Scotch pine, American plum, northern whitecedar.	Green ash, jack pine, eastern white pine, golden willow.	Silver maple, eastern cottonwood, Siouxland cottonwood.
Lundlake	---	Redosier dogwood	Black ash, green ash, black spruce, northern whitecedar.	Eastern cottonwood, golden willow, black willow.	Siouxland cottonwood.

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1192:					
Crowriver	Redosier dogwood	American plum, silver buffaloberry, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Green ash, golden willow, black willow.	Eastern cottonwood, Siouxland cottonwood.
Lundlake	---	Redosier dogwood	Black ash, northern whitecedar.	Eastern cottonwood, golden willow, black willow.	Siouxland cottonwood.
1193:					
Cosmos	---	Redosier dogwood, eastern redcedar, Black Hills spruce, chokecherry, silver buffaloberry.	Amur maple, hackberry, white spruce, blue spruce, Scotch pine, American plum, northern whitecedar.	Jack pine, eastern white pine, golden willow, black willow.	Silver maple, green ash, eastern cottonwood, Siouxland cottonwood.
1197:					
Cohoctah	---	Redosier dogwood, cotoneaster, eastern redcedar, silver buffaloberry.	Norway spruce, Austrian pine, northern whitecedar.	Green ash, eastern white pine.	Silver maple, eastern cottonwood, Siouxland cottonwood.
1198B:					
Rohrbeck	---	Amur maple, Siberian peashrub, gray dogwood, cotoneaster, eastern redcedar, lilac, American cranberrybush.	Hackberry, Norway spruce, bur oak.	Red pine, eastern white pine.	---
Koronis	---	Siberian peashrub, redosier dogwood, blue spruce, chokecherry, lilac.	Amur maple, hackberry, eastern redcedar, Black Hills spruce.	Green ash, eastern white pine.	---
1204B:					
Reedslake	---	Siberian peashrub, redosier dogwood, cotoneaster, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Hackberry, eastern redcedar, Norway spruce, white spruce, Black Hills spruce, bur oak.	Green ash, black walnut, jack pine, eastern white pine, American basswood.	Silver maple, Siouxland cottonwood.

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1213C: Cokato	---	Siberian peashrub, redosier dogwood, cotoneaster, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, white spruce, Black Hills spruce, bur oak.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
Storden	American plum	Siberian peashrub, hackberry, eastern redcedar.	Sugar maple, green ash, honeylocust.	Siberian elm	---
1220C: Cokato	---	Siberian peashrub, redosier dogwood, blue spruce, American plum, chokecherry, silver buffaloberry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce, white spruce, Black Hills spruce, bur oak.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.
Storden	American plum	Siberian peashrub, hackberry, eastern redcedar.	Green ash, honeylocust.	Siberian elm	---
Hawick	Siberian peashrub	Late lilac	Green ash, thornless honeylocust, eastern redcedar, Norway spruce, jack pine, Austrian pine.	Red pine, eastern white pine, Siberian elm.	---
1362B: Angus	---	Siberian peashrub, redosier dogwood, blue spruce, chokecherry, lilac.	Amur maple, sugar maple, hackberry, eastern redcedar, Norway spruce.	Green ash, eastern white pine.	---
1383A: Shorewood	---	Lilac, northern whitecedar.	Hackberry, white spruce, Black Hills spruce, Austrian pine.	Green ash, eastern white pine.	Silver maple, Siouxland cottonwood.
1384: Minneopa	---	Redosier dogwood, eastern redcedar, blue spruce, lilac.	Amur maple, white spruce, northern whitecedar.	Hackberry, green ash, Austrian pine, eastern white pine.	Silver maple.
1385: Havelock	---	Redosier dogwood, lilac, northern whitecedar.	Hackberry, eastern redcedar, white spruce.	Green ash, golden willow, black willow.	Silver maple, eastern cottonwood.

Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1387A:					
Collinwood------	---	Cotoneaster, lilac, northern whitecedar.	Hackberry, white spruce, Black Hills spruce, Austrian pine.	Green ash, eastern white pine.	Silver maple, Siouxland cottonwood.
1391B:					
Wadenill---------	---	Siberian peashrub, redosier dogwood, cotoneaster, blue spruce, chokecherry, lilac.	Amur maple, hackberry, eastern redcedar, Norway spruce.	Green ash, eastern white pine.	---
Sunburg---------	American plum, late lilac, lilac.	Siberian peashrub, hackberry, eastern redcedar, honeysuckle, Black Hills spruce.	Green ash, thornless honeylocust.	---	---
1406:					
Medo------------	---	Silky dogwood, honeysuckle.	Tall purple willow	Black willow------	Imperial Carolina poplar.
1801B:					
Gardencity------	---	Siberian peashrub, redosier dogwood, eastern redcedar, Black Hills spruce, American plum, common chokecherry, silver buffaloberry, lilac.	Hackberry, Norway spruce, red pine, bur oak.	Green ash, black walnut, jack pine, eastern white pine.	Silver maple, Siouxland cottonwood.

Windbreak Suitability Groups

(See text for descriptions of the groups listed in this table)

Map symbol and soil name	Windbreak suitability group
8B, 8C, 8D:	
Sparta	7
35:	
Blue Earth	2, drained; 10, undrained
39A:	
Wadena	6G
41A:	
Estherville	7
85:	
Calco	2K
86:	
Canisteo	2K
96B:	
Collinwood	4
101B:	
Truman	3
102B:	
Clarion	3
106C2:	
Lester	3
112:	
Harps	2K
113:	
Webster	2
114:	
Glencoe	2, drained; 10, undrained
129:	
Cylinder	1
130:	
Nicollet	1
134:	
Okoboji	2
136:	
Madelia	2
140:	
Spicer	2K
143B:	
Chelsea	7
178:	
Granby	2, drained; 10, undrained

Windbreak Suitability Groups--Continued

Map symbol and soil name	Windbreak suitability group
181:	
Litchfield	1
183:	
Dassel	2, drained; 10, undrained
197:	
Kingston	1
211:	
Lura	2
229:	
Waldorf	2
239:	
Le Sueur	1
281:	
Darfur	2
286B:	
Shorewood	4
311C2:	
Shorewood	4C
327A, 327B:	
Dickman	7
399:	
Biscay	2, drained; 10, undrained
415:	
Kanaranzi	6G
423:	
Seaforth	1K
461B, 461C2:	
Koronis	3
511:	
Marcellon	1
523:	
Houghton	2H
525:	
Muskego	2H, drained; 10, ponded
539:	
Klossner	2H
548:	
Medo	2H
610:	
Calco	2K
611D:	
Hawick	7

Windbreak Suitability Groups--Continued

Map symbol and soil name	Windbreak suitability group
612B:	
Wadenill	3
613:	
Grovecity	1
664:	
Zook	2
740:	
Hamel	2
Glencoe	2, drained; 10, undrained
804B, 804C2, 804D2, 804E:	
Koronis	3
Sunburg	8
Hawick	7
805C2, 805D2:	
Sunburg	8
Wadenill	3
807D2:	
Koronis	3
Sunburg	8
875B:	
Estherville	7
Hawick	7
875C:	
Hawick	7
Estherville	7
887B:	
Clarion	3
Swanlake	8
899:	
Harps	2K
Okoboji	2
909C2, 909D2:	
Bold	8
Truman	3
920B:	
Clarion	3
Storden	8
Hawick	7

Windbreak Suitability Groups--Continued

Map symbol and soil name	Windbreak suitability group
945D2, 945E:	
Lester	3
Storden	8
956:	
Canisteo	2K
Glencoe	2, drained; 10, undrained
960C2, 960D2:	
Storden	8
Omsrud	3
978:	
Cordova	2
Rolfe	2
1016:	
Udorthents	10
1080:	
Klossner	10
Okoboji	10
Glencoe	10
1096:	
Fieldon	2K
Dassel	2, drained; 10, undrained
1097:	
Mayer	2K
Biscay	2, drained; 10, undrained
1098:	
Biscay	2
Biscay, depressional	2, drained; 10, undrained
1099:	
Granby	5, drained; 2, undrained
1100:	
Nicollet	1
1101:	
Webster	2
1159B:	
Strout	4C
Arkton	1K
1161:	
Barry	2

Windbreak Suitability Groups--Continued

Map symbol and soil name	Windbreak suitability group
1162A, 1162B:	
Kandiyohi	4C
1163:	
Cohoctah	1, drained; 2, undrained
1165:	
Lundlake	2, drained; 10, undrained
1168:	
Swedegrove	2K
Lundlake	2, drained; 10, undrained
1169:	
Corvuso	2K
Lura	2
1171C, 1171D:	
Newlondon	1K
Strout	4
1172C:	
Sparta	7
Gardencity	5
1174:	
Danielson	2
1175:	
Swedegrove	2K
1177C:	
Gardencity	5
Bold	8
1178:	
Uniongrove	2
1183:	
Crowriver	2K
1184:	
Corvuso	2K
1185:	
Gardencity	5
1186:	
Forestcity	2
Lundlake	2, drained; 10, undrained
1192:	
Crowriver	2K
Lundlake	2, drained; 10, undrained

Windbreak Suitability Groups--Continued

Map symbol and soil name	Windbreak suitability group
1193:	
Cosmos	2
1197:	
Cohoctah	1, drained; 2, undrained
1198B:	
Rohrbeck	3
Koronis	3
1199:	
Klossner	10
Lundlake	10
1203:	
Muskego	10
Blue Earth	10
Houghton	10
1204B:	
Reedslake	3
1213C:	
Cokato	3
Storden	8
1220C:	
Cokato	3
Storden	8
Hawick	7
1362B:	
Angus	3
1383A:	
Shorewood	4
1384:	
Minneopa	1
1385:	
Havelock	2L
1387A:	
Collinwood	4
1391B:	
Wadenill	3
Sunburg	8
1406:	
Medo	2H
Dassel	2, drained; 10, undrained
Biscay	2, drained; 10, undrained

Windbreak Suitability Groups--Continued

Map symbol and soil name	Windbreak suitability group
1801B:	
Gardencity	5

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Woodland Management and Productivity

The eastern part of Meeker County and a fringe of land bordering lakes and large marshes were wooded at the time of settlement. The woodland that remains forms part of the western edge of the northern deciduous forest region commonly referred to as the Big Woods. Native species included basswood, hard maple, bur oak, white oak, red oak, ash, birch, soft maple, wild cherry, cottonwood, and willow. A large prairie occupied the western and central parts of the county (see map, Original Vegetation). Small tracts of prairie also existed within the forested area.

There are several forest types in the county. These are the aspen-oak forest type, which is the largest in extent; the Big Woods; the brush-prairie type; the oak openings and barrens type, which makes up only a small acreage, mostly around lakes and large marshes in the western part of the county; and the river bottom forest type, which is the smallest in extent (Marschner, 1974).

Most of the woodland in the county is now in small woodlots or on steep slopes bordering lakes and major rivers and streams. About 4 percent of the county is woodlots. The present distribution of tree species is similar to that in the original forest types, but wood production is limited. Many wooded areas are a source of firewood and are used for recreation or for homesites. A few areas are grazed.

The table "Woodland Management and Productivity" can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the ordination symbol, a number, indicates the potential productivity of the soils for an indicator tree species. The first species listed under *common trees* for a soil is the indicator species for that soil. It is the dominant species on the soil and the one that determines the ordination class. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter R indicates steep slopes; X, stoniness or rockiness; W, excess water in or on the soil; T, toxic substances in the soil; D, restricted rooting depth; C, clay in the upper part of the soil; S, sandy texture; F, a high content of rock fragments in the soil; and N, snowpack. The letter A indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and N.

In the table, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Woodlands that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of slight indicates that no particular prevention measures are needed under ordinary conditions. A rating of moderate indicates that erosion-control measures are needed in certain silvicultural activities. A rating of severe indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of slight indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of moderate indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of severe indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of slight indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of moderate indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of severe indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of slight indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of moderate indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of severe indicates that many trees can be blown down during these periods.

Plant competition ratings indicate the degree to which undesirable species are expected to invade and grow when openings are made in the tree canopy. The main factors that affect plant competition are the depth to the water table and the available water capacity. A rating of slight indicates that competition from undesirable plants is not likely to prevent natural regeneration or suppress the more desirable species. Planted seedlings can become established without undue competition. A rating of moderate indicates that competition may delay the establishment of desirable species. Competition may hamper stand development, but it will not prevent the eventual development of fully stocked stands. A rating of severe indicates that competition can be expected to prevent regeneration unless precautionary measures are applied.

The potential productivity of merchantable or *common trees* on a soil is expressed as a site index and as a productivity class.

The *site index* is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *productivity class*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic meters per hectare per year, indicates the amount of wood fiber produced in a fully stocked, even-aged stand.

Trees to plant are those that are suitable for commercial wood production.

Woodland Management and Productivity

(Only the soils suitable for production of commercial trees are listed. See text for definitions of terms used in this table)

		Management concerns					Potential productivity			
Map symbol and soil name	Ordination symbol	Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class*	Trees to plant
106C2:										
Lester----------	5A	Slight	Slight	Slight	Slight	Severe	Northern red oak----	65	5	Silver maple, black walnut, white oak, northern red oak.
							Eastern white pine--	65	10	
							Eastern cottonwood--	90	7	
							American basswood---	70	5	
							Black walnut--------	62	---	
							White oak-----------	60	4	
143B:										
Chelsea---------	5S	Slight	Slight	Moderate	Slight	Moderate	White oak-----------	70	5	Jack pine, red pine, eastern white pine.
							Quaking aspen-------	72	6	
							Jack pine-----------	70	7	
							Red pine------------	72	9	
							Eastern white pine--	83	13	
239:										
Le Sueur--------	3A	Slight	Slight	Slight	Slight	Severe	Sugar maple---------	60	3	Black walnut, eastern cottonwood, American basswood.
							Bur oak-------------	43	2	
							Black walnut--------	55	---	
							Eastern cottonwood--	85	6	
							American basswood---	70	5	
286B:										
Shorewood-------	3A	Slight	Slight	Slight	Slight	Severe	Sugar maple---------	60	3	Black walnut, eastern white pine, eastern cottonwood.
							American basswood---	70	5	
							Black walnut--------	60	3	
							Eastern cottonwood--	85	6	
311C2:										
Shorewood-------	3A	Slight	Slight	Slight	Slight	Severe	Sugar maple---------	60	3	Black walnut, eastern white pine, eastern cottonwood.
							American basswood---	70	5	
							Black walnut--------	60	3	
							Eastern cottonwood--	85	6	
461B, 461C2:										
Koronis---------	4A	Slight	Slight	Slight	Slight	Slight	Northern red oak----	69	4	Silver maple, black walnut, white spruce, eastern white pine, white oak, northern red oak, American basswood.
							Eastern redcedar----	39	3	
							Black walnut--------	62	---	
							Eastern white pine--	64	9	
							White oak-----------	62	4	
							Sugar maple---------	64	3	
							American basswood---	69	4	

See footnote at end of table.

Woodland Management and Productivity--Continued

Map symbol and soil name	Ordination symbol	Management concerns					Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class*	
523:										
Houghton	2W	Slight	Severe	Severe	Severe	Severe	Red maple	56	2	---
							Silver maple	82	2	
							White ash	56	3	
							Green ash	---	---	
							Tamarack	52	3	
							Quaking aspen	60	4	
							Northern whitecedar	37	4	
525:										
Muskego	3W	Slight	Severe	Severe	Severe	Severe	Tamarack	50	3	---
740:										
Hamel	5W	Slight	Moderate	Moderate	Slight	Severe	American basswood	70	5	Silver maple, black ash, eastern cottonwood.
							Black ash	50	2	
							Eastern cottonwood	85	6	
Glencoe.										
804B, 804C2:										
Koronis	4A	Slight	Slight	Slight	Slight	Slight	Northern red oak	69	4	Silver maple, black walnut, white spruce, eastern white pine, white oak, northern red oak, American basswood.
							Eastern redcedar	39	3	
							Black walnut	62	---	
							Eastern white pine	64	9	
							White oak	62	4	
							Sugar maple	64	3	
							American basswood	69	4	
Sunburg.										
Hawick.										
804D2, 804E:										
Koronis	4R	Moderate	Moderate	Slight	Slight	Slight	Northern red oak	69	4	Silver maple, black walnut, white spruce, eastern white pine, white oak, northern red oak, American basswood.
							Eastern redcedar	39	3	
							Black walnut	62	---	
							Eastern white pine	64	9	
							White oak	62	4	
							Sugar maple	64	3	
							American basswood	69	4	
Sunburg.										
Hawick.										

See footnote at end of table.

Woodland Management and Productivity--Continued

Map symbol and soil name	Ordination symbol	Management concerns					Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class*	
807D2:										
Koronis	4R	Moderate	Moderate	Slight	Slight	Slight	Northern red oak	69	4	Silver maple, black walnut, white spruce, eastern white pine, white oak, northern red oak, American basswood.
							Eastern redcedar	39	3	
							Black walnut	62	---	
							Eastern white pine	64	9	
							White oak	62	4	
							Sugar maple	64	3	
							American basswood	69	4	
Sunburg.										
945D2, 945E:										
Lester	5R	Moderate	Moderate	Slight	Slight	Severe	Northern red oak	70	5	Silver maple, black walnut, white oak, northern red oak.
							Eastern white pine	65	10	
							Eastern cottonwood	90	7	
							American basswood	70	5	
							Black walnut	62	---	
							White oak	60	4	
Storden.										
978:										
Cordova	4W	Slight	Moderate	Moderate	Slight	Severe	American basswood	60	4	Black ash, eastern cottonwood.
							Sugar maple	55	2	
							Green ash	52	3	
							Eastern cottonwood	90	7	
Rolfe.										
1099:										
Granby	2W	Slight	Severe	Severe	Severe	Severe	Silver maple	82	2	White spruce, Austrian pine, eastern white pine, northern whitecedar.
							Red maple	68	3	
							White ash	---	---	
							Eastern cottonwood	---	---	
							Quaking aspen	---	---	
							American basswood	---	---	
1161:										
Barry	3W	Slight	Moderate	Moderate	Slight	Severe	American basswood	55	3	Black ash, green ash, eastern cottonwood.
							Green ash	50	2	
							Eastern cottonwood	85	6	
1163:										
Cohoctah	1W	Slight	Severe	Moderate	Moderate	Severe	Silver maple	60	1	Silver maple, green ash, white spruce, eastern cottonwood, American basswood.
							Green ash	60	1	
							Eastern cottonwood	90	7	
							American basswood	80	4	
1173:										
Muskego	3W	Slight	Severe	Severe	Severe	Severe	Tamarack	50	3	---
Klossner.										

See footnote at end of table.

Woodland Management and Productivity--Continued

Map symbol and soil name	Ordination symbol	Management concerns					Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class*	
1186:										
Forestcity------	5W	Slight	Moderate	Moderate	Slight	Severe	American basswood---	70	5	Silver maple, black ash, eastern cottonwood.
							Black ash-----------	50	2	
							Eastern cottonwood--	85	6	
Lundlake.										
1198B:										
Rohrbeck--------	4A	Slight	Slight	Moderate	Slight	Moderate	Northern red oak----	65	4	Black walnut, eastern white pine, white oak, northern red oak.
							Sugar maple---------	55	2	
							Eastern cottonwood--	85	6	
							Bur oak-------------	40	2	
							American basswood---	60	4	
							White oak-----------	55	3	
Koronis---------	4A	Slight	Slight	Slight	Slight	Slight	Northern red oak----	69	4	Silver maple, black walnut, white spruce, eastern white pine, white oak, northern red oak, American basswood.
							Sugar maple---------	64	3	
							Eastern redcedar----	39	3	
							Black walnut--------	62	---	
							Eastern white pine--	64	9	
							White oak-----------	62	4	
							American basswood---	69	4	
1204B:										
Reedslake-------	5A	Slight	Slight	Slight	Slight	Severe	Northern red oak----	70	5	Black walnut, white oak, northern red oak.
							Eastern cottonwood--	90	7	
							American basswood---	70	5	
							White oak-----------	60	4	
1213C:										
Cokato----------	5A	Slight	Slight	Slight	Slight	Severe	Northern red oak----	70	5	Black walnut, white oak, northern red oak.
							Eastern cottonwood--	90	7	
							American basswood---	70	5	
							White oak-----------	60	4	
Storden.										
1220C:										
Cokato----------	5A	Slight	Slight	Slight	Slight	Severe	Northern red oak----	70	5	Black walnut, white oak, northern red oak.
							Eastern cottonwood--	90	7	
							American basswood---	70	5	
							White oak-----------	60	4	
Storden.										
Hawick.										
1362B:										
Angus-----------	5A	Slight	Slight	Slight	Slight	Severe	Northern red oak----	70	5	Silver maple, black walnut, white oak, northern red oak.
							Eastern white pine--	65	10	
							Eastern cottonwood--	90	7	
							American basswood---	70	5	
							Black walnut--------	62	---	
							White oak-----------	60	4	

See footnote at end of table.

Woodland Management and Productivity--Continued

Map symbol and soil name	Ordination symbol	Management concerns					Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	Productivity class*	
1383A:										
Shorewood--------	3A	Slight	Slight	Slight	Slight	Severe	Sugar maple--------- American basswood--- Black walnut-------- Eastern cottonwood--	60 70 60 85	3 5 3 6	Black walnut, eastern white pine, eastern cottonwood.

* Productivity class is the yield in cubic meters per hectare per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

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Recreation

Meeker County offers many opportunities for fishing, hunting, canoeing, hiking, camping, bird watching, and other outdoor activities. Many lakes, streams, and other areas provide ample opportunity for recreational development. The lakes in the county are used for boating, swimming, and fishing. Public access areas are provided on the larger lakes and on the North Fork of the Crow River. Many of the lakes have swimming beaches and picnic areas. Overnight camping is available on the east shore of Lake Ripley, and picnic sites are at several locations near the lake. Picnic areas are also available on the Crow River at Kingston and at Forest City. Association 4, which is described under the heading "General Soil Map Units" in Part I of this survey, is characterized by many marshes and lakes that are well suited to recreational development. The North Fork of the Crow River, which is within association 17, is part of a designated canoe route administered by the Minnesota Department of Natural Resources.

The soils of the survey area are rated in the table "Recreational Development" according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites, and either access to public sewer lines or the capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degrees, for recreational uses by the duration of flooding and the season when it occurs. Onsite assessment of the height, duration, intensity, and frequency of flooding is essential in planning recreational facilities.

Camp areas are tracts of land used intensively as sites for tents, trailers, and campers and for outdoor activities that accompany such sites. These areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The soils are rated on the basis of soil properties that influence the ease of developing camp areas and performance of the areas after development. Also considered are the soil properties that influence trafficability and promote the growth of vegetation after heavy use.

Picnic areas are natural or landscaped tracts of land that are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The soils are rated on the basis of soil properties that influence the cost of shaping the site, trafficability, and the growth of vegetation after development. The surface of picnic areas should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry.

Playgrounds are areas used intensively for baseball, football, or similar activities. These areas require a nearly level soil that is free of stones and that can withstand heavy foot traffic and maintain an adequate cover of vegetation. The soils are rated on the basis of soil properties that influence the cost of shaping the site, trafficability, and the growth of vegetation. Slope and stoniness are the main concerns in developing playgrounds. The surface of the playgrounds should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry.

Paths and trails are areas used for hiking and horseback riding. The areas should require little or no cutting and filling during site preparation. The soils are rated on the basis of soil properties that influence trafficability and erodibility. Paths and trails should remain firm under foot traffic and not be dusty when dry.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

The interpretive ratings in this table help engineers, planners, and others to understand how soil properties influence recreational uses. Ratings for proposed uses are given in terms of limitations. Only the most restrictive features are listed. Other features may limit a specific recreational use.

The degree of soil limitation is expressed as slight, moderate, or severe.

Slight means that soil properties are favorable for the rated use. The limitations are minor and can be easily overcome. Good performance and low maintenance are expected.

Moderate means that soil properties are moderately favorable for the rated use. The limitations can be overcome or modified by special planning, design, or maintenance. During some part of the year, the expected performance may be less desirable than that of soils rated *slight*.

Severe means that soil properties are unfavorable for the rated use. Examples of limitations are slope, bedrock near the surface, flooding, and a seasonal high water table. These limitations generally require major soil reclamation, special design, or intensive maintenance. Overcoming the limitations generally is difficult and costly.

The information in the table "Recreational Development" can be supplemented by other information in this survey, for example, interpretations for dwellings without basements and for local roads and streets in the table "Building Site Development" and interpretations for septic tank absorption fields in the table "Sanitary Facilities."

Recreational Development

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable)

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
8B:					
Sparta----------	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.	Moderate: droughty.
8C:					
Sparta----------	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
8D:					
Sparta----------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.	Severe: slope.
35:					
Blue Earth------	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
39A:					
Wadena----------	Slight------------	Slight------------	Slight------------	Slight------------	Slight.
41A:					
Estherville-----	Slight------------	Slight------------	Moderate: small stones.	Slight------------	Moderate: droughty.
85:					
Calco-----------	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
86:					
Canisteo--------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
96B:					
Collinwood------	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight------------	Slight.
101B:					
Truman----------	Slight------------	Slight------------	Moderate: slope.	Slight------------	Slight.
102B:					
Clarion---------	Slight------------	Slight------------	Moderate: slope.	Slight------------	Slight.
106C2:					
Lester----------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight------------	Moderate: slope.
112:					
Harps-----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
113:					
Webster---------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
114:					
Glencoe----------	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
129:					
Cylinder---------	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight------------	Slight.
130:					
Nicollet---------	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight------------	Slight.
134:					
Okoboji----------	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
136:					
Madelia----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
140:					
Spicer-----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
143B:					
Chelsea----------	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
178:					
Granby-----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
181:					
Litchfield-------	Slight------------	Slight------------	Slight------------	Slight------------	Moderate: droughty.
183:					
Dassel-----------	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
197:					
Kingston---------	Slight------------	Slight------------	Moderate: slope.	Slight------------	Slight.
211:					
Lura-------------	Severe: ponding, too clayey.	Severe: ponding, too clayey.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
229:					
Waldorf----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
239:					
Le Sueur---------	Slight------------	Slight------------	Moderate: slope.	Slight------------	Slight.
281:					
Darfur-----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
286B:					
Shorewood	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
311C2:					
Shorewood	Severe: too clayey.	Severe: too clayey.	Severe: slope, too clayey.	Severe: too clayey.	Severe: too clayey.
327A:					
Dickman	Slight	Slight	Slight	Slight	Moderate: droughty.
327B:					
Dickman	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
399:					
Biscay	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
415:					
Kanaranzi	Slight	Slight	Slight	Slight	Moderate: droughty.
423:					
Seaforth	Slight	Slight	Moderate: slope.	Slight	Slight.
461B:					
Koronis	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
461C2:					
Koronis	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
511:					
Marcellon	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
523:					
Houghton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.
525:					
Muskego	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
539:					
Klossner	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
548:					
Medo	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
610:					
Calco	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
611D:					
Hawick	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Slight	Severe: slope.
612B:					
Wadenill	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
613:					
Grovecity	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
664:					
Zook	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
740:					
Hamel	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Glencoe	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
804B:					
Koronis	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
Sunburg	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
Hawick	Slight	Slight	Severe: small stones.	Slight	Moderate: droughty.
804C2:					
Koronis	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Sunburg	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Hawick	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Severe: too sandy.	Severe: slope.
804D2:					
Koronis	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Sunburg	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
804D2:					
Hawick	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Slight	Severe: slope.
804E:					
Koronis	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sunburg	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Hawick	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Slight	Severe: slope.
805C2:					
Sunburg	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Wadenill	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
805D2:					
Sunburg	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Wadenill	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
807D2:					
Koronis	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Sunburg	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
875B:					
Estherville	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
Hawick	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
875C:					
Hawick	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Slight	Moderate: droughty, slope.
Estherville	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
887B:					
Clarion	Slight	Slight	Moderate: slope.	Slight	Slight.
Swanlake	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
899:					
Harps	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Okoboji	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
909C2:					
Bold	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Truman	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
909D2:					
Bold	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
Truman	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
920B:					
Clarion	Slight	Slight	Moderate: slope.	Slight	Slight.
Storden	Slight	Slight	Moderate: slope.	Slight	Slight.
Hawick	Slight	Slight	Severe: small stones.	Slight	Moderate: droughty.
945D2:					
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
945E:					
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
956:					
Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Glencoe	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
960C2:					
Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Omsrud	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
960D2:					
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Omsrud	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
978:					
Cordova	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Rolfe	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1015:					
Udipsamments	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, too sandy.
1016:					
Udorthents	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
1030:					
Pits, gravel.					
Udipsamments	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Severe: slope.
1080:					
Klossner	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Okoboji	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Glencoe	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1096:					
Fieldon	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Dassel	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1097:					
Mayer	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Biscay	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1098:					
Biscay	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Biscay, depressional	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1099:					
Granby	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1100:					
Nicollet	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
1101:					
Webster	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1159B:					
Strout	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
Arkton	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones.	Slight	Slight.
1161:					
Barry	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
1162A:					
Kandiyohi	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
1162B:					
Kandiyohi	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
1163:					
Cohoctah	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
Lundlake	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1168:					
Swedegrove	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Lundlake	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1169:					
Corvuso	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Lura	Severe: ponding, too clayey.	Severe: ponding, too clayey.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
1171C:					
Newlondon	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
Strout	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1171D:					
Newlondon	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Strout	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
1172C:					
Sparta	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: droughty, slope.
Gardencity	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
1173:					
Muskego	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.	Severe: ponding, flooding, excess humus.
Klossner	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.	Severe: ponding, flooding, excess humus.
1174:					
Danielson	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1175:					
Swedegrove	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1176:					
Litchfield	Slight	Slight	Slight	Slight	Moderate: droughty.
1177C:					
Gardencity	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Bold	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
1178:					
Uniongrove	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1183:					
Crowriver	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1184:					
Corvuso	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1185:					
Gardencity	Slight	Slight	Slight	Slight	Slight.

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1186:					
Forestcity	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Lundlake	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1192:					
Crowriver	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Lundlake	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1193:					
Cosmos	Severe: wetness, too clayey.	Severe: wetness, too clayey.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
1197:					
Cohoctah	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
1198B:					
Rohrbeck	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Slight.
Koronis	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
1199:					
Klossner	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Lundlake	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1203:					
Muskego	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Blue Earth	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Houghton	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
1204B:					
Reedslake	Slight	Slight	Moderate: slope.	Slight	Slight.
1213C:					
Cokato	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.

Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1220C:					
Cokato	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Hawick	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Slight	Moderate: droughty, slope.
1362B:					
Angus	Slight	Slight	Moderate: slope.	Slight	Slight.
1383A:					
Shorewood	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
1384:					
Minneopa	Slight	Slight	Moderate: small stones.	Slight	Moderate: droughty.
1385:					
Havelock	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
1387A:					
Collinwood	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
1391B:					
Wadenill	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
Sunburg	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
1406:					
Medo	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding, excess humus.
Dassel	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Biscay	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1801B:					
Gardencity	Slight	Slight	Moderate: slope.	Slight	Slight.

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Wildlife Habitat

The soils of Meeker County have the potential to provide excellent habitat for various kinds of wildlife. Wildlife in the area include several species of migratory waterfowl. Canada geese are the most common. Mink, muskrat, beaver, and other small furbearers inhabit water areas. Ponded soils, such as Muskego, Blue Earth, and Houghton soils, are well suited to wetland wildlife habitat. Upland birds include pheasant, Hungarian partridge, and other species. Other animals in the survey area include rabbit, fox, squirrel, and other small mammals and deer. There are many small fishing lakes in the county. The main sport fish are walleye, northern pike, crappie, and sunfish. Some of the better fishing lakes are Big Swan, Koronis, Minnebelle, Jennie, and Stella. The Crow River provides good fishing for northern pike, walleye, and catfish.

Wildlife populations can be increased by using crop rotations, planting crops in strips, and seeding ditchbanks and field borders. These measures provide a variety of cover for wildlife.

Scattered throughout the county are tracts of land set aside to preserve the natural wetlands. These areas provide excellent habitat and are used by waterfowl and pheasants.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. If food, cover, or water is missing, inadequate, or inaccessible, wildlife will be scarce or will not inhabit the area.

If the soils have potential for habitat development, wildlife habitat can be created or improved by planting appropriate vegetation, properly managing the existing plant cover, and fostering the natural establishment of desirable plants.

Elements of Wildlife Habitat

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants used by wildlife. Examples are corn, soybeans, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes planted for wildlife food and cover. Examples are bromegrass, timothy, orchardgrass, clover, alfalfa, wheatgrass, and birdsfoot trefoil.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are bluestems, indiangrass, blueberry, goldenrod, lambsquarters, dandelions, blackberry, ragweed, wheatgrass, and nightshade.

The major soil properties affecting the growth of grain and forage crops and wild herbaceous plants are depth of the root zone, texture of the surface layer, the amount of water available to plants, wetness, salinity, and flooding. The length of the growing season also is important.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage that wildlife eat. Examples are oak, poplar, box elder, birch, maple, green ash, willow, and American elm. Examples of fruit-producing shrubs that are suitable for planting on soils that have good potential for these plants are hawthorn, honeysuckle, American plum, redosier dogwood, chokecherry, highbush cranberry, elderberry, gooseberry, serviceberry, silver buffaloberry, and crabapple.

Coniferous plants are cone-bearing trees, shrubs, and ground cover that provide habitat or supply food in the form of browse, seed, or fruit-like cones. Examples are pine, spruce, cedar, and tamarack.

The major soil properties affecting the growth of hardwood and coniferous trees and shrubs are depth of the root zone, the amount of water available to plants, and wetness.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Wetland plants produce food or cover for wetland wildlife. Examples of these plants are smartweeds, wild millet, rushes, sedges, bulrushes, wild rice, arrowhead, waterplantain, cattail, prairie cordgrass, bluejoint grass, asters, and beggarticks.

The major soil properties affecting wetland plants are texture of the surface layer, wetness, acidity or alkalinity, and slope.

Shallow water areas have an average depth of less than 5 feet. They are useful as habitat for some wildlife species. They are naturally wet areas or are created by dams, levees, or water-control measures in marshes or streams. Examples are waterfowl feeding areas, wildlife watering developments, beaver ponds, and other wildlife ponds.

The major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability.

Kinds of Wildlife Habitat

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, and shrubs. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include Hungarian partridge, ring-necked pheasant, bobwhite quail, sharp-tailed grouse, meadowlark, field sparrow, killdeer, cottontail rabbit, and red fox.

Habitat for woodland wildlife consists of areas of hardwoods or conifers or a mixture of these and associated grasses, legumes, and wild herbaceous plants. The wildlife attracted to this habitat include wild turkey, ruffed grouse, thrushes, woodpeckers, owls, tree squirrels, porcupine, raccoon, white-tailed deer, black bear, and moose.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas, bogs, or flood plains that support water-tolerant plants. The wildlife attracted to this habitat include ducks, geese, herons, bitterns, rails, kingfishers, muskrat, otter, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. The wildlife attracted to rangeland include antelope, deer, sage grouse, and meadowlark.

Wildlife Habitat

(See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable)

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
8B:											
Sparta----------	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	---
8C, 8D:											
Sparta----------	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	---
35:											
Blue Earth------	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Poor	Good	Fair.
39A:											
Wadena----------	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	---
41A:											
Estherville-----	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	---
85:											
Calco-----------	Good	Fair	Good	Poor	Very poor.	Good	Good	Fair	Poor	Fair	---
86:											
Canisteo--------	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
96B:											
Collinwood------	Good	Good	Good	Good	Good	Poor	Poor	Fair	Good	Poor	---
101B:											
Truman----------	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.	---
102B:											
Clarion---------	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	---
106C2:											
Lester----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
112:											
Harps-----------	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good	---
113:											
Webster---------	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good	---
114:											
Glencoe---------	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
129:											
Cylinder--------	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair	---
130:											
Nicollet--------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	---

Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
134: Okoboji----------	Fair	Fair	Fair	Fair	Very poor.	Good	Good	Fair	Fair	Good	---
136: Madelia----------	Good	Good	Good	Good	Fair	Good	Good	Good	Fair	Good	---
140: Spicer-----------	Good	Good	Fair	Fair	Poor	Good	Good	Good	Fair	Good	---
143B: Chelsea----------	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	---
178: Granby-----------	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	---
181: Litchfield-------	Fair	Good	Good	Good	Good	Fair	Poor	Good	Good	Poor	---
183: Dassel-----------	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	---
197: Kingston---------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	---
211: Lura-------------	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	---
229: Waldorf----------	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
239: Le Sueur---------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	---
281: Darfur-----------	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good	---
286B: Shorewood--------	Good	Good	Good	Good	Good	Poor	Poor	Fair	Good	Poor	---
311C2: Shorewood--------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
327A, 327B: Dickman----------	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	---
399: Biscay-----------	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good	---
415: Kanaranzi--------	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	---
423: Seaforth---------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	---
461B: Koronis----------	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---

Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
461C2:											
Koronis	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
511:											
Marcellon	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair	---
523:											
Houghton	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	---
525:											
Muskego	Good	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good	---
539:											
Klossner	Good	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good	---
548:											
Medo	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good	---
610:											
Calco	Good	Fair	Good	Poor	Very poor.	Good	Good	Fair	Poor	Fair	---
611D:											
Hawick	Very poor.	Very poor.	Fair	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	---
612B:											
Wadenill	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	---
613:											
Grovecity	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	---
664:											
Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good	---
740:											
Hamel	Good	Good	Fair	Good	Fair	Good	Good	Good	Fair	Good	---
Glencoe	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
804B:											
Koronis	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
Sunburg	Good	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.	---
Hawick	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	---
804C2:											
Koronis	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
Sunburg	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	---
Hawick	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	---

Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
804D2:											
Koronis----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
Sunburg----------	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	---
Hawick-----------	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	---
804E:											
Koronis----------	Poor	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Fair	Very poor.	---
Sunburg----------	Poor	Poor	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	---
Hawick-----------	Very poor.	Very poor.	Fair	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	---
805C2:											
Sunburg----------	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	---
Wadenill---------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
805D2:											
Sunburg----------	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	---
Wadenill---------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	---
807D2:											
Koronis----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
Sunburg----------	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	---
875B:											
Estherville------	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	---
Hawick-----------	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	---
875C:											
Hawick-----------	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	---
Estherville------	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	---
887B:											
Clarion----------	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	---
Swanlake---------	Good	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.	---

Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
899:											
Harps	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good	---
Okoboji	Fair	Fair	Fair	Fair	Very poor.	Good	Good	Fair	Fair	Good	---
909C2:											
Bold	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
Truman	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.	---
909D2:											
Bold	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	---
Truman	Fair	Good	Good	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	---
920B:											
Clarion	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	---
Storden	Good	Good	Good	Fair	Poor	Very poor.	Very poor.	Good	Fair	Very poor.	Very poor.
Hawick	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	---
945D2:											
Lester	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
Storden	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
945E:											
Lester	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	---
Storden	Poor	Fair	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
956:											
Canisteo	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
Glencoe	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
960C2:											
Storden	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
Omsrud	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
960D2:											
Storden	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
Omsrud	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	---

Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
978:											
Cordova	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good	---
Rolfe	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good	---
1015: Udipsamments.											
1016:											
Udorthents	Poor	Poor	Fair	Good	Good	Poor	Very poor.	Poor	Fair	Very poor.	Fair.
1030: Pits, gravel.											
Udipsamments.											
1080:											
Klossner	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	---
Okoboji	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	---
Glencoe	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	---
1096:											
Fieldon	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good	---
Dassel	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	---
1097:											
Mayer	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
Biscay	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good	---
1098:											
Biscay	Good	Good	Good	Good	Fair	Good	Good	Good	Fair	Good	---
Biscay, depressional	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good	---
1099:											
Granby	Poor	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good	---
1100:											
Nicollet	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	---
1101:											
Webster	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good	---
1159B:											
Strout	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	---
Arkton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	---
1161:											
Barry	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good	---

Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
1162A, 1162B:											
Kandiyohi-------	Fair	Fair	Fair	Good	Good	Poor	Poor	Poor	Fair	Poor	---
1163:											
Cohoctah--------	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good	---
1165:											
Lundlake--------	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
1168:											
Swedegrove------	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
Lundlake--------	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
1169:											
Corvuso---------	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
Lura------------	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	---
1171C:											
Newlondon-------	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	---
Strout----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
1171D:											
Newlondon-------	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	---
Strout----------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	---
1172C:											
Sparta----------	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	---
Gardencity------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
1173:											
Muskego---------	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Poor	Poor	Good	---
Klossner--------	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	---
1174:											
Danielson-------	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good	---
1175:											
Swedegrove------	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
1176:											
Litchfield------	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	---
1177C:											
Gardencity------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
Bold------------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---

Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
1178:											
Uniongrove------	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good	---
1183:											
Crowriver--------	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good	---
1184:											
Corvuso----------	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
1185:											
Gardencity------	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
1186:											
Forestcity------	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
Lundlake---------	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
1192:											
Crowriver--------	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good	---
Lundlake---------	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good	---
1193:											
Cosmos-----------	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good	---
1197:											
Cohoctah---------	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	---
1198B:											
Rohrbeck---------	Fair	Good	Good	Fair	Good	Very poor.	Very poor.	Fair	Good	Very poor.	---
Koronis----------	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
1199:											
Klossner---------	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	---
Lundlake---------	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	---
1203:											
Muskego----------	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	---
Blue Earth------	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	Very poor.
Houghton---------	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	---
1204B:											
Reedslake--------	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
1213C:											
Cokato-----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---

Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
1213C:											
Storden----------	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
1220C:											
Cokato-----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
Storden----------	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.	Very poor.
Hawick-----------	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	---
1362B:											
Angus------------	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---
1383A:											
Shorewood--------	Good	Good	Good	Good	Good	Poor	Poor	Fair	Good	Poor	---
1384:											
Minneopa---------	Fair	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor	---
1385:											
Havelock---------	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good	---
1387A:											
Collinwood-------	Good	Good	Good	Good	Good	Poor	Poor	Fair	Good	Poor	---
1391B:											
Wadenill---------	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	---
Sunburg----------	Good	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.	---
1406:											
Medo-------------	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good	---
Dassel-----------	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	---
Biscay-----------	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good	---
1801B:											
Gardencity-------	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	---

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Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

The table "Building Site Development" shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features generally are favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills generally are limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, potential for frost action, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

The table “Sanitary Facilities” shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. It also shows the suitability of the soils for use as a daily cover for landfill.

Soil properties are important in selecting sites for sanitary facilities and in identifying limiting soil properties and site features to be considered in planning, design, and installation. Soil limitation ratings of *slight, moderate,* or *severe* are given for septic tank absorption fields, sewage lagoons, and trench and area sanitary landfills. Soil suitability ratings of *good, fair,* and *poor* are given for daily cover for landfill.

A rating of *slight* or *good* indicates that the soils have no limitations or that the limitations can be easily overcome. Good performance and low maintenance can be expected. A rating of *moderate* or *fair* indicates that the limitations should be recognized but generally can be overcome by good management or special design. A rating of *severe* or *poor* indicates that overcoming the limitations is difficult or impractical. Increased maintenance may be required.

Septic tank absorption fields are areas in which subsurface systems of tile or perforated pipe distribute effluent from a septic tank into the natural soil. The centerline of the tile is assumed to be at a depth of 24 inches. Only the part of the soil between depths of 24 and 60 inches is considered in making the ratings. The soil properties and site features considered are those that affect the absorption of the effluent, those that affect the construction and maintenance of the system, and those that may affect public health.

The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted, relatively impervious soil material. Aerobic lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Relatively impervious soil material for the lagoon floor and sides is desirable to minimize seepage and contamination of local ground water.

The table "Sanitary Facilities" gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Trench sanitary landfill is an area where solid waste is disposed of by placing refuse in successive layers in an excavated trench. The waste is spread, compacted, and covered daily with a thin layer of soil that is excavated from the trench. When the trench is full, a final cover of soil material at least 2 feet thick is placed over the landfill. Soil properties that influence the risk of pollution, the ease of excavation, trafficability, and revegetation are the major considerations in rating the soils.

Area sanitary landfill is an area where solid waste is disposed of by placing refuse in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil that is imported from a source away from the site. A final cover of soil at least 2 feet thick is placed over the completed landfill. Soil properties that influence trafficability, revegetation, and the risk of pollution are the main considerations in rating the soils for area sanitary landfills.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. The ratings in the table "Sanitary Facilities" are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste. The suitability of a soil for use as cover is based on properties that affect workability and the ease of digging, moving, and spreading the material over the refuse daily during both wet and dry periods.

Soil texture, wetness, rock fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Waste Management

Soil properties are important when organic waste is applied as fertilizer and wastewater is applied in irrigated areas. They also are important when the soil is used as a medium for the treatment and disposal of the organic waste and wastewater. Unfavorable soil properties can result in environmental damage.

The use of organic waste and wastewater as production resources results in energy and resource conservation and minimizes the problems associated with waste disposal. If disposal is the goal, applying a maximum amount of the organic waste or the wastewater to a minimal area holds costs to a minimum and environmental damage is the main hazard. If reuse is the goal, a minimum amount should be applied to a maximum area and environmental damage is unlikely.

Interpretations developed for waste management may include ratings for manure- and food-processing waste, municipal sewage sludge, use of wastewater for irrigation, and treatment of wastewater by slow rate, overland flow, and rapid infiltration processes.

Specific information regarding waste management is available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Construction Materials

The table "Construction Materials" gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In the table "Construction Materials," the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel, or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have one or more of the following characteristics: a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In the table "Construction Materials," only the probability of finding material in suitable quantity in or below the soil is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils generally is preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

The table "Water Management" gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features generally are favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In the table "Water Management," the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even more than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff.

Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Building Site Development

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
8B:						
Sparta	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
8C:						
Sparta	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
8D:						
Sparta	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
35:						
Blue Earth	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
39A:						
Wadena	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
41A:						
Estherville	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
85:						
Calco	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
86:						
Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
96B:						
Collinwood	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
101B:						
Truman	Slight	Slight	Slight	Moderate: slope.	Severe: low strength, frost action.	Slight.
102B:						
Clarion	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Slight.
106C2:						
Lester	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
112:						
Harps-----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
113:						
Webster---------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
114:						
Glencoe---------	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
129:						
Cylinder--------	Severe: cutbanks cave, wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.	Slight.
130:						
Nicollet--------	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
134:						
Okoboji---------	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
136:						
Madelia---------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
140:						
Spicer----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
143B:						
Chelsea---------	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
178:						
Granby----------	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
181:						
Litchfield------	Severe: cutbanks cave.	Slight---------	Moderate: wetness.	Slight---------	Moderate: frost action.	Moderate: droughty.
183:						
Dassel----------	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
197: Kingston	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Severe: low strength, frost action.	Slight.
211: Lura	Severe: excess humus, ponding.	Severe: ponding, shrink-swell, low strength.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell, low strength.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, too clayey.
229: Waldorf	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
239: Le Sueur	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
281: Darfur	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
286B: Shorewood	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
311C2: Shorewood	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, frost action.	Severe: too clayey.
327A: Dickman	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
327B: Dickman	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
399: Biscay	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: ponding.
415: Kanaranzi	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Moderate: droughty.
423: Seaforth	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Severe: frost action.	Slight.
461B: Koronis	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
461C2: Koronis	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
511: Marcellon	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
523: Houghton	Severe: ponding, excess humus.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: excess humus, ponding.
525: Muskego	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
539: Klossner	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
548: Medo	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
610: Calco	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
611D: Hawick	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
612B: Wadenill	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
613: Grovecity	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Severe: frost action.	Slight.
664: Zook	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
740:						
Hamel	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
Glencoe	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
804B:						
Koronis	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
Sunburg	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
Hawick	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
804C2:						
Koronis	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Sunburg	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Hawick	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
804D2:						
Koronis	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sunburg	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Hawick	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
804E:						
Koronis	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sunburg	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Hawick	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
805C2:						
Sunburg	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Wadenill	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
805D2:						
Sunburg	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Wadenill	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
807D2:						
Koronis	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sunburg	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
875B:						
Estherville	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Hawick	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
875C:						
Hawick	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Estherville	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
887B:						
Clarion	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Slight.
Swanlake	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
899:						
Harps	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
Okoboji	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
909C2:						
Bold	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
Truman	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
909D2:						
Bold	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, frost action.	Severe: slope.

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
909D2:						
Truman	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
920B:						
Clarion	Moderate: wetness.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Slight.
Storden	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
Hawick	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
945D2:						
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
945E:						
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
956:						
Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
Glencoe	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
960C2:						
Storden	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
Omsrud	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
960D2:						
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Omsrud	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
978: Cordova	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
Rolfe	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
1015: Udipsamments	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty, too sandy.
1016: Udorthents	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
1030: Pits, gravel.						
Udipsamments	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
1080: Klossner	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, low strength, ponding.	Severe: ponding, excess humus.
Okoboji	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
Glencoe	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
1096: Fieldon	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
Dassel	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
1097: Mayer	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
Biscay	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: ponding.

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1098:						
Biscay----------	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness.	Severe: wetness.
Biscay, depressional---	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: ponding.
1099:						
Granby----------	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1100:						
Nicollet--------	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.	Slight.
1101:						
Webster---------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
1159B:						
Strout----------	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
Arkton----------	Moderate: too clayey, wetness.	Severe: shrink-swell.	Moderate: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
1161:						
Barry-----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
1162A, 1162B:						
Kandiyohi-------	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Severe: too clayey.
1163:						
Cohoctah--------	Severe: cutbank cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness, flooding.
1165:						
Lundlake--------	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
1168:						
Swedegrove------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
Lundlake--------	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1169:						
Corvuso---------	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
Lura------------	Severe: excess humus, ponding.	Severe: ponding, shrink-swell, low strength.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell, low strength.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, too clayey.
1171C:						
Newlondon-------	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: slope.
Strout----------	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: slope.
1171D:						
Newlondon-------	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
Strout----------	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
1172C:						
Sparta----------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Gardencity------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
1173:						
Muskego---------	Severe: excess humus, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, ponding, flooding.	Severe: ponding, flooding, excess humus.
Klossner--------	Severe: excess humus, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, low strength, ponding.	Severe: ponding, flooding, excess humus.
1174:						
Danielson-------	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
1175:						
Swedegrove------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1176:						
Litchfield	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Moderate: droughty.
1177C:						
Gardencity	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Bold	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: frost action.	Moderate: slope.
1178:						
Uniongrove	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
1183:						
Crowriver	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
1184:						
Corvuso	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
1185:						
Gardencity	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Severe: frost action.	Slight.
1186:						
Forestcity	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
Lundlake	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
1192:						
Crowriver	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.	Severe: wetness.
Lundlake	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
1193:						
Cosmos	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness, too clayey.
1197:						
Cohoctah	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.	Severe: wetness.

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1198B:						
Rohrbeck	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Slight	Slight.
Koronis	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
1199:						
Klossner	Severe: excess humus, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, ponding.	Severe: subsides, low strength, ponding.	Severe: ponding, excess humus.
Lundlake	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
1203:						
Muskego	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
Blue Earth	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
Houghton	Severe: excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
1204B:						
Reedslake	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength.	Slight.
1213C:						
Cokato	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Storden	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
1220C:						
Cokato	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Storden	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
Hawick	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.

Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1362B:						
Angus-----------	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
1383A:						
Shorewood--------	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.
1384:						
Minneopa---------	Severe: cutbanks cave.	Slight---------	Moderate: wetness.	Slight---------	Moderate: frost action.	Moderate: droughty.
1385:						
Havelock---------	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness, flooding.
1387A:						
Collinwood------	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.
1391B:						
Wadenill---------	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
Sunburg----------	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
1406:						
Medo-------------	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding.	Severe: subsides, ponding, low strength.	Severe: subsides, ponding, frost action.	Severe: ponding, excess humus.
Dassel-----------	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, frost action.	Severe: ponding.
Biscay-----------	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: ponding.
1801B:						
Gardencity------	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.

Sanitary Facilities

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
8B:					
Sparta----------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
8C:					
Sparta----------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
8D:					
Sparta----------	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
35:					
Blue Earth------	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
39A:					
Wadena----------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
41A:					
Estherville-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
85:					
Calco-----------	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
86:					
Canisteo--------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
96B:					
Collinwood------	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
101B:					
Truman----------	Moderate: percs slowly.	Moderate: seepage, slope.	Slight------------	Slight------------	Good.
102B:					
Clarion---------	Slight------------	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
106C2:					
Lester----------	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
112:					
Harps-----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
113:					
Webster---------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
114:					
Glencoe---------	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
129:					
Cylinder--------	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
130:					
Nicollet--------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
134:					
Okoboji---------	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
136:					
Madelia---------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
140:					
Spicer----------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
143B:					
Chelsea---------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
178:					
Granby----------	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
181:					
Litchfield------	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy.

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
183:					
Dassel	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
197:					
Kingston	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
211:					
Lura	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey, excess humus.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
229:					
Waldorf	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
239:					
Le Sueur	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
281:					
Darfur	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness.
286B:					
Shorewood	Severe: wetness, percs slowly.	Severe: wetness.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
311C2:					
Shorewood	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: too clayey.	Moderate: wetness, slope.	Poor: too clayey, hard to pack.
327A:					
Dickman	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
327B:					
Dickman	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
399:					
Biscay	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
415:					
Kanaranzi	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
423:					
Seaforth	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
461B:					
Koronis	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
461C2:					
Koronis	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
511:					
Marcellon	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
523:					
Houghton	Severe: subsides, ponding, percs slowly.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding, excess humus.	Severe: ponding, seepage.	Poor: ponding, excess humus.
525:					
Muskego	Severe: subsides, ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: hard to pack, ponding.
539:					
Klossner	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
548:					
Medo	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
610:					
Calco	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
611D:					
Hawick	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
612B:					
Wadenill	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: small stones.

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
613:					
Grovecity-------	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: wetness.
664:					
Zook------------	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
740:					
Hamel-----------	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
Glencoe---------	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
804B:					
Koronis---------	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Sunburg---------	Slight------------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: small stones.
Hawick----------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
804C2:					
Koronis---------	Moderate: percs slowly, slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
Sunburg---------	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: small stones, slope.
Hawick----------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
804D2:					
Koronis---------	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
Sunburg---------	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
Hawick----------	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
804E:					
Koronis	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
Sunburg	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
Hawick	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
805C2:					
Sunburg	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: small stones, slope.
Wadenill	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: small stones, slope.
805D2:					
Sunburg	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
Wadenill	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
807D2:					
Koronis	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
Sunburg	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
875B:					
Estherville	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Hawick	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
875C:					
Hawick	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Estherville	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
887B:					
Clarion	Slight	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
Swanlake	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
899:					
Harps	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Okoboji	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
909C2:					
Bold	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Truman	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
909D2:					
Bold	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Truman	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
920B:					
Clarion	Slight	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
Storden	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Hawick	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
945D2:					
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
945E:					
Lester	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
956:					
Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Glencoe	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
960C2:					
Storden	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Omsrud	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
960D2:					
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Omsrud	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
978:					
Cordova	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Rolfe	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
1015:					
Udipsamments	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
1016:					
Udorthents	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
1030: Pits, gravel.					
Udipsamments	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
1080:					
Klossner	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
Okoboji	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1080:					
Glencoe	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
1096:					
Fieldon	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness.
Dassel	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
1097:					
Mayer	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
Biscay	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
1098:					
Biscay	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
Biscay, depressional	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
1099:					
Granby	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
1100:					
Nicollet	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
1101:					
Webster	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1159B:					
Strout	Severe: wetness, percs slowly.	Severe: wetness.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Arkton	Severe: wetness, percs slowly.	Severe: wetness.	Moderate: wetness, too clayey.	Moderate: wetness.	Poor: hard to pack.

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1161:					
Barry	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
1162A:					
Kandiyohi	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
1162B:					
Kandiyohi	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
1163:					
Cohoctah	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness, seepage.	Poor: wetness.
1165:					
Lundlake	Severe: ponding, percs slowly.	Severe: ponding.	Severe: seepage, ponding.	Severe: ponding.	Poor: ponding.
1168:					
Swedegrove	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
Lundlake	Severe: ponding, percs slowly.	Severe: ponding.	Severe: seepage, ponding.	Severe: ponding.	Poor: ponding.
1169:					
Corvuso	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Lura	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey, excess humus.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
1171C:					
Newlondon	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: too clayey.	Moderate: wetness, slope.	Poor: too clayey, hard to pack.
Strout	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: too clayey.	Moderate: wetness, slope.	Poor: too clayey, hard to pack.
1171D:					
Newlondon	Severe: wetness, percs slowly, slope.	Severe: slope, wetness.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1171D:					
Strout----------	Severe: wetness, percs slowly, slope.	Severe: slope, wetness.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
1172C:					
Sparta----------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Gardencity------	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
1173:					
Muskego---------	Severe: subsides, flooding, ponding.	Severe: seepage, flooding, excess humus.	Severe: flooding, ponding, excess humus.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus.
Klossner--------	Severe: subsides, flooding, ponding.	Severe: seepage, flooding, excess humus.	Severe: flooding, ponding.	Severe: flooding, seepage, ponding.	Poor: hard to pack, ponding.
1174:					
Danielson-------	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
1175:					
Swedegrove------	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
1176:					
Litchfield------	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
1177C:					
Gardencity------	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
Bold------------	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
1178:					
Uniongrove------	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
1183:					
Crowriver-------	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1184:					
Corvuso	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
1185:					
Gardencity	Severe: wetness.	Severe: seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage.	Poor: too sandy.
1186:					
Forestcity	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
Lundlake	Severe: ponding, percs slowly.	Severe: ponding.	Severe: seepage, ponding.	Severe: ponding.	Poor: ponding.
1192:					
Crowriver	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
Lundlake	Severe: ponding, percs slowly.	Severe: ponding.	Severe: seepage, ponding.	Severe: ponding.	Poor: ponding.
1193:					
Cosmos	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
1197:					
Cohoctah	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness.
1198B:					
Rohrbeck	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: wetness.
Koronis	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
1199:					
Klossner	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
Lundlake	Severe: ponding, percs slowly.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: ponding.

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1203:					
Muskego----------	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: ponding, excess humus.	Severe: seepage, ponding.	Poor: hard to pack, ponding.
Blue Earth------	Severe: ponding.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
Houghton---------	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, excess humus.	Severe: seepage, ponding.	Poor: ponding, excess humus.
1204B:					
Reedslake--------	Severe: wetness.	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Good.
1213C:					
Cokato-----------	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Storden----------	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
1220C:					
Cokato-----------	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Storden----------	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Hawick-----------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
1362B:					
Angus------------	Severe: wetness.	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
1383A:					
Shorewood--------	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
1384:					
Minneopa---------	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.

Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1385:					
Havelock	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
1387A:					
Collinwood	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
1391B:					
Wadenill	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: small stones.
Sunburg	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: small stones.
1406:					
Medo	Severe: subsides, ponding, percs slowly.	Severe: seepage, excess humus, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Dassel	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Biscay	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: seepage, too sandy, small stones.
1801B:					
Gardencity	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.

Construction Materials

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
8B, 8C:				
Sparta	Good	Probable	Improbable: too sandy.	Poor: too sandy.
8D:				
Sparta	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
35:				
Blue Earth	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
39A:				
Wadena	Good	Probable	Probable	Poor: small stones, area reclaim.
41A:				
Estherville	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
85:				
Calco	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
86:				
Canisteo	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
96B:				
Collinwood	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
101B:				
Truman	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
102B:				
Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
106C2:				
Lester	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
112:				
Harps	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
113:				
Webster	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
114:				
Glencoe	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
129:				
Cylinder	Fair: wetness.	Probable	Probable	Poor: small stones.
130:				
Nicollet	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
134:				
Okoboji	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
136:				
Madelia	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
140:				
Spicer	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
143B:				
Chelsea	Good	Probable	Improbable: too sandy.	Poor: too sandy.
178:				
Granby	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
181:				
Litchfield	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy, thin layer.
183:				
Dassel	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
197:				
Kingston	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
211:				
Lura	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
229:				
Waldorf	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
239:				
Le Sueur	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
281:				
Darfur	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
286B:				
Shorewood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
311C2:				
Shorewood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
327A:				
Dickman	Good	Probable	Improbable: too sandy.	Poor: too sandy.
327B:				
Dickman	Good	Probable	Improbable: too sandy.	Poor: too sandy.
399:				
Biscay	Poor: wetness.	Probable	Probable	Poor: area reclaim, wetness.
415:				
Kanaranzi	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
423:				
Seaforth	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
461B:				
Koronis	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
461C2:				
Koronis	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
511:				
Marcellon	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
523:				
Houghton	Poor: wetness, low strength.	Improbable: excess humus.	Improbable: excess humus.	Poor: wetness, excess humus.

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
525:				
Muskego	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
539:				
Klossner	Poor: thin layer, wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
548:				
Medo	Poor: wetness.	Probable	Probable	Poor: excess humus, wetness.
610:				
Calco	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
611D:				
Hawick	Fair: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
612B:				
Wadenill	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
613:				
Grovecity	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
664:				
Zook	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
740:				
Hamel	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Glencoe	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
804B:				
Koronis	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Sunburg	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Hawick	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
804C2:				
Koronis	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Sunburg	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Hawick	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
804D2:				
Koronis	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Sunburg	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Hawick	Fair: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
804E:				
Koronis	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Sunburg	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Hawick	Poor: slope.	Probable	Probable	Poor: too sandy, small stones, area reclaim.
805C2:				
Sunburg	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Wadenill	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
805D2:				
Sunburg	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Wadenill	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
807D2:				
Koronis	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Sunburg	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
875B:				
Estherville	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Hawick	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
875C:				
Hawick	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Estherville	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
887B:				
Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Swanlake	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
899:				
Harps	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Okoboji	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
909C2:				
Bold	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Truman	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
909D2:				
Bold	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Truman	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
920B:				
Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Storden	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
920B:				
Hawick	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
945D2:				
Lester	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Storden	Fair: shrink-swell, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
945E:				
Lester	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Storden	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
956:				
Canisteo	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Glencoe	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
960C2:				
Storden	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Omsrud	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
960D2:				
Storden	Fair: shrink-swell, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Omsrud	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
978:				
Cordova	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Rolfe	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
1015:				
Udipsamments	Good	Probable	Probable	Poor: too sandy.

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1016:				
Udorthents	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
1030: Pits, gravel.				
Udipsamments	Fair: slope.	Probable	Probable	Poor: too sandy, slope.
1080:				
Klossner	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
Okoboji	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Glencoe	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1096:				
Fieldon	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Dassel	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
1097:				
Mayer	Poor: wetness.	Probable	Probable	Poor: small stones, area reclaim, wetness.
Biscay	Poor: wetness.	Probable	Probable	Poor: area reclaim, wetness.
1098:				
Biscay	Poor: wetness.	Probable	Probable	Poor: area reclaim, wetness.
Biscay, depressional	Poor: wetness.	Probable	Probable	Poor: area reclaim, wetness.
1099:				
Granby	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
1100:				
Nicollet	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1101:				
Webster	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1159B:				
Strout	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Arkton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
1161:				
Barry	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
1162A, 1162B:				
Kandiyohi	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
1163:				
Cohoctah	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
1165:				
Lundlake	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1168:				
Swedegrove	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Lundlake	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1169:				
Corvuso	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Lura	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
1171C:				
Newlondon	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Strout	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
1171D:				
Newlondon	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
Strout	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1172C:				
Sparta	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Gardencity	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
1173:				
Muskego	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
Klossner	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
1174:				
Danielson	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
1175:				
Swedegrove	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1176:				
Litchfield	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy, thin layer.
1177C:				
Gardencity	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
Bold	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
1178:				
Uniongrove	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1183:				
Crowriver	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1184:				
Corvuso	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
1185:				
Gardencity	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
1186:				
Forestcity	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Lundlake	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1192:				
Crowriver	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Lundlake	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1193:				
Cosmos	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
1197:				
Cohoctah	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1198B:				
Rohrbeck	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
Koronis	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
1199:				
Klossner	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
Lundlake	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1203:				
Muskego	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
Blue Earth	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Houghton	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness.
1204B:				
Reedslake	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
1213C:				
Cokato	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Storden	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
1220C:				
Cokato	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.

Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1220C:				
Storden	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Hawick	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
1362B:				
Angus	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
1383A:				
Shorewood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
1384:				
Minneopa	Good	Probable	Probable	Poor: too sandy, small stones.
1385:				
Havelock	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1387A:				
Collinwood	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
1391B:				
Wadenill	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Sunburg	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
1406:				
Medo	Poor: wetness.	Probable	Probable	Poor: excess humus, wetness.
Dassel	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Biscay	Poor: wetness.	Probable	Probable	Poor: area reclaim, wetness.
1801B:				
Gardencity	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.

Water Management

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable)

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
8B: Sparta	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
8C, 8D: Sparta	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
35: Blue Earth	Moderate: seepage.	Severe: piping, excess humus, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Ponding	Wetness.
39A: Wadena	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Favorable	Too sandy	Favorable.
41A: Estherville	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
85: Calco	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
86: Canisteo	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action	Wetness	Wetness	Wetness.
96B: Collinwood	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action, slope.	Slope, wetness.	Wetness, percs slowly.	Percs slowly.
101B: Truman	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope	Erodes easily	Erodes easily.

Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
102B: Clarion	Moderate: seepage, slope.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Slope	Erodes easily	Erodes easily.
106C2: Lester	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
112: Harps	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action	Wetness, rooting depth.	Wetness	Wetness, rooting depth.
113: Webster	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action	Wetness	Wetness	Wetness.
114: Glencoe	Moderate: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Ponding	Wetness.
129: Cylinder	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Favorable.
130: Nicollet	Moderate: seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Frost action	Wetness	Wetness	Favorable.
134: Okoboji	Slight	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Ponding	Wetness.
136: Madelia	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action	Wetness	Erodes easily, wetness.	Wetness, erodes easily.
140: Spicer	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action	Wetness	Erodes easily, wetness.	Wetness, erodes easily.

Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
143B: Chelsea---------	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
178: Granby----------	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty.
181: Litchfield------	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty.
183: Dassel----------	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding--------	Ponding, too sandy.	Wetness.
197: Kingston--------	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Frost action---	Wetness--------	Erodes easily, wetness.	Erodes easily.
211: Lura------------	Slight---------	Severe: excess humus, hard to pack, ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
229: Waldorf---------	Slight---------	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
239: Le Sueur--------	Moderate: seepage.	Severe: thin layer.	Moderate: deep to water, slow refill.	Frost action---	Wetness--------	Wetness--------	Favorable.
281: Darfur----------	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness--------	Wetness, too sandy.	Wetness.

Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
286B: Shorewood-------	Moderate: seepage, slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness.	Erodes easily, wetness.	Erodes easily, percs slowly.
311C2: Shorewood-------	Severe: slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, slow intake.	Slope, erodes easily, wetness.	Slope, erodes easily, percs slowly.
327A: Dickman---------	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
327B: Dickman---------	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
399: Biscay----------	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, frost action.	Ponding--------	Ponding, too sandy.	Wetness.
415: Kanaranzi-------	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Droughty-------	Erodes easily, too sandy.	Erodes easily, droughty.
423: Seaforth--------	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Frost action---	Wetness--------	Wetness--------	Favorable.
461B: Koronis---------	Severe: seepage.	Slight---------	Severe: no water.	Deep to water	Slope----------	Favorable------	Favorable.
461C2: Koronis---------	Severe: seepage, slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Slope----------	Slope.
511: Marcellon-------	Severe: seepage.	Severe: seepage, piping, wetness.	Moderate: slow refill.	Frost action---	Wetness--------	Wetness--------	Wetness.

Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
523: Houghton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Frost action, subsides, ponding.	Ponding, soil blowing.	Ponding, soil blowing.	Wetness.
525: Muskego	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, percs slowly.	Ponding, soil blowing, percs slowly.	Ponding, soil blowing, percs slowly.	Wetness, percs slowly.
539: Klossner	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding, soil blowing.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily.
548: Medo	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.
610: Calco	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
611D: Hawick	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy.	Slope, droughty.
612B: Wadenill	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope	Favorable	Favorable.
613: Grovecity	Severe: seepage.	Severe: piping.	Moderate: deep to water.	Frost action	Wetness	Wetness	Favorable.
664: Zook	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
740: Hamel	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Frost action	Wetness	Wetness	Wetness.

Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
740:							
Glencoe	Moderate: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Ponding	Wetness.
804B:							
Koronis	Severe: seepage.	Slight	Severe: no water.	Deep to water	Slope	Favorable	Favorable.
Sunburg	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Soil blowing	Favorable.
Hawick	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty.	Too sandy	Droughty.
804C2, 804D2, 804E:							
Koronis	Severe: seepage, slope.	Slight	Severe: no water.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Slope.
Sunburg	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Slope.
Hawick	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy.	Slope, droughty.
805C2, 805D2:							
Sunburg	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Slope.
Wadenill	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope	Slope	Slope.
807D2:							
Koronis	Severe: seepage, slope.	Slight	Severe: no water.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Slope.
Sunburg	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Slope.

Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
875B:							
Estherville	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
Hawick	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty.	Too sandy, soil blowing.	Droughty.
875C:							
Hawick	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy.	Slope, droughty.
Estherville	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
887B:							
Clarion	Moderate: seepage, slope.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Slope	Erodes easily	Erodes easily.
Swanlake	Moderate: seepage, slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope	Erodes easily	Erodes easily.
899:							
Harps	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action	Wetness, rooting depth.	Wetness	Wetness, rooting depth.
Okoboji	Slight	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Ponding	Wetness.
909C2, 909D2:							
Bold	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Truman	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
920B:							
Clarion	Moderate: seepage, slope.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Slope	Erodes easily	Erodes easily.

Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
920B:							
Storden----------	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Erodes easily	Erodes easily.
Hawick----------	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty.	Too sandy------	Droughty.
945D2, 945E:							
Lester----------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, rooting depth.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
Storden----------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
956:							
Canisteo---------	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action---	Wetness--------	Wetness--------	Wetness.
Glencoe----------	Moderate: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding--------	Ponding--------	Wetness.
960C2, 960D2:							
Storden----------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Omsrud----------	Severe: slope.	Moderate: piping.	Severe: no water.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
978:							
Cordova----------	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Frost action---	Wetness--------	Wetness--------	Wetness.
Rolfe------------	Moderate: seepage.	Severe: ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, percs slowly, erodes easily.	Erodes easily, ponding.	Wetness, erodes easily, percs slowly.
1015:							
Udipsamments-----	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.

Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1016:							
Udorthents	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty.	Slope, soil blowing.	Slope, droughty.
1030: Pits, gravel.							
Udipsamments	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
1080:							
Klossner	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding	Ponding	Wetness.
Okoboji	Slight	Severe: ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Erodes easily, ponding.	Wetness, erodes easily.
Glencoe	Moderate: seepage.	Severe: excess humus, hard to pack, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Ponding	Wetness.
1096:							
Fieldon	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Wetness.
Dassel	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding	Ponding, too sandy.	Wetness.
1097:							
Mayer	Severe: seepage.	Severe: seepage, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Wetness.
Biscay	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, frost action.	Ponding	Ponding, too sandy.	Wetness.

Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1098: Biscay	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: cutbanks cave.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Wetness.
Biscay, depressional	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, frost action.	Ponding	Ponding, too sandy.	Wetness.
1099: Granby	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Ponding, too sandy, soil blowing.	Wetness, droughty.
1100: Nicollet	Moderate: seepage.	Moderate: wetness.	Moderate: deep to water, slow refill.	Frost action	Wetness	Wetness	Favorable.
1101: Webster	Moderate: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action	Wetness	Wetness	Wetness.
1159B: Strout	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Slope, wetness, slow intake.	Erodes easily, wetness.	Erodes easily, rooting depth.
Arkton	Moderate: slope.	Moderate: piping, hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness.	Erodes easily, wetness.	Erodes easily, rooting depth.
1161: Barry	Severe: seepage.	Severe: piping, wetness.	Moderate: slow refill.	Frost action	Wetness, rooting depth.	Wetness	Wetness, rooting depth.
1162A: Kandiyohi	Slight	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action.	Wetness, slow intake.	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.

Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1162B:							
Kandiyohi	Moderate: slope.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, slow intake.	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.
1163:							
Cohoctah	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
1165:							
Lundlake	Moderate: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Ponding	Wetness.
1168:							
Swedegrove	Severe: seepage.	Severe: piping, wetness.	Slight	Frost action	Wetness	Wetness	Wetness.
Lundlake	Moderate: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Ponding	Wetness.
1169:							
Corvuso	Slight	Severe: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, rooting depth.
Lura	Slight	Severe: excess humus, hard to pack, ponding.	Severe: slow refill.	Ponding, percs slowly, frost action.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
1171C, 1171D:							
Newlondon	Severe: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness.	Slope, erodes easily, wetness.	Slope, erodes easily, rooting depth.
Strout	Severe: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Slope, wetness.	Slope, erodes easily, wetness.	Slope, erodes easily, rooting depth.

Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1172C:							
Sparta----------	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
Gardencity------	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope, too sandy, soil blowing.	Slope.
1173:							
Muskego---------	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, flooding, subsides.	Ponding, soil blowing, percs slowly.	Ponding, soil blowing.	Wetness.
Klossner--------	Severe: seepage.	Severe: hard to pack, ponding.	Severe: slow refill.	Ponding, flooding, subsides.	Ponding, soil blowing, flooding.	Erodes easily, ponding, soil blowing.	Wetness, erodes easily.
1174:							
Danielson-------	Slight---------	Severe: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, rooting depth, percs slowly.
1175:							
Swedegrove------	Severe: seepage.	Severe: piping, wetness.	Slight---------	Frost action---	Wetness--------	Wetness--------	Wetness.
1176:							
Litchfield------	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Cutbanks cave	Wetness, droughty, soil blowing.	Wetness, too sandy, soil blowing.	Droughty.
1177C:							
Gardencity------	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Slope, too sandy, soil blowing.	Slope.
Bold------------	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
1178:							
Uniongrove------	Severe: seepage.	Severe: piping, wetness.	Slight---------	Frost action---	Wetness--------	Wetness--------	Wetness.

Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1183: Crowriver	Severe: seepage.	Severe: piping, wetness.	Slight	Frost action	Wetness, soil blowing.	Wetness, soil blowing.	Wetness.
1184: Corvuso	Slight	Severe: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, rooting depth.
1185: Gardencity	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Deep to water	Soil blowing	Too sandy, soil blowing.	Favorable.
1186: Forestcity	Severe: seepage.	Severe: wetness.	Moderate: slow refill.	Frost action	Wetness, soil blowing.	Wetness, soil blowing.	Wetness.
Lundlake	Moderate: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Ponding	Wetness.
1192: Crowriver	Severe: seepage.	Severe: piping, wetness.	Slight	Frost action	Wetness, soil blowing.	Wetness, soil blowing.	Wetness.
Lundlake	Moderate: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Ponding	Wetness.
1193: Cosmos	Slight	Severe: wetness.	Severe: no water.	Percs slowly, frost action.	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Wetness, rooting depth, percs slowly.
1197: Cohoctah	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Flooding, frost action.	Wetness, flooding.	Wetness, soil blowing.	Wetness.
1198B: Rohrbeck	Severe: seepage.	Severe: piping.	Severe: cutbanks cave.	Slope	Slope, wetness, fast intake.	Erodes easily, wetness, soil blowing.	Erodes easily.
Koronis	Severe: seepage.	Slight	Severe: no water.	Deep to water	Slope, soil blowing.	Soil blowing	Favorable.

Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1199:							
Klossner	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding	Ponding	Wetness.
Lundlake	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Ponding	Wetness.
1203:							
Muskego	Severe: seepage.	Severe: piping, excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding	Ponding	Wetness.
Blue Earth	Moderate: seepage.	Severe: piping, excess humus, ponding.	Severe: slow refill.	Ponding, frost action.	Ponding	Ponding	Wetness.
Houghton	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill.	Ponding, subsides, frost action.	Ponding	Ponding	Wetness.
1204B:							
Reedslake	Moderate: seepage, slope.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Slope	Erodes easily	Erodes easily.
1213C:							
Cokato	Severe: slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Storden	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
1220C:							
Cokato	Severe: slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Storden	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Hawick	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty.	Slope, too sandy.	Slope, droughty.

Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1362B:							
Angus	Moderate: seepage, slope.	Moderate: wetness.	Moderate: deep to water, slow refill.	Deep to water	Slope	Favorable	Favorable.
1383A:							
Shorewood	Moderate: seepage.	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Percs slowly.
1384:							
Minneopa	Severe: seepage.	Severe: seepage.	Severe: cutbanks cave.	Deep to water	Droughty	Too sandy	Droughty.
1385:							
Havelock	Severe: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
1387A:							
Collinwood	Slight	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Percs slowly.
1391B:							
Wadenill	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope	Favorable	Favorable.
Sunburg	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Soil blowing	Favorable.
1406:							
Medo	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides, frost action.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.
Dassel	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, frost action, cutbanks cave.	Ponding, soil blowing.	Ponding, too sandy, soil blowing.	Wetness.
Biscay	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, frost action.	Ponding	Ponding, too sandy.	Wetness.

Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1801B:							
Gardencity------	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Too sandy, soil blowing.	Favorable.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features listed in tables are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

The table "Engineering Index Properties" gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given in the series descriptions in Part I of this survey.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

The tables "Physical Properties of the Soils" and "Chemical Properties of the Soils" show estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given in the series descriptions in Part I of this survey.

Clay as a soil separate, or component, consists of mineral soil particles that are less than 0.002 millimeter in diameter. The estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $^1/_3$-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In the table "Physical Properties of the Soils," the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, more than 9 percent, is sometimes used.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In the table "Physical Properties of the Soils," the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, very fine sand, sand, and organic matter (as much as 4 percent) and on soil structure and permeability. The estimates are modified by the presence of rock fragments. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils generally are not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams that have more than 5 percent finely divided calcium carbonate. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils have less than 5 percent finely divided calcium carbonate. They are moderately erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils have less than 5 percent finely divided calcium carbonate. They are moderately erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils have less than 5 percent finely divided calcium carbonate. They are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of rock fragments on the surface or because of surface wetness.

The *wind erodibility index* is a number that is determined based on the percentage of dry, nonerodible surface soil aggregates larger than 0.84 millimeter in diameter. It is an expression of the stability of the soil aggregates, or the extent to which they are broken down by tillage and the abrasion caused by windblown soil particles.

In the table "Chemical Properties of the Soils," *cation-exchange capacity* is the total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. It is a measurement of the nutrient-holding capacity of the soil.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Calcium carbonate is expressed as a weighted percentage of the fraction of the soil less than 2 millimeters in size. The availability of plant nutrients, such as phosphorus, is affected by the amount of carbonates in the soil.

Gypsum is expressed as the percent, by weight, of hydrated calcium sulfates in the fraction of the soil less than 20 millimeters in size. Soils high in gypsum, such as those more than 10 percent gypsum, may collapse if the gypsum is removed by percolating water. Gypsum is corrosive to concrete. Corrosion of concrete is most likely to occur in soils that are more than about 1 percent gypsum when wetting and drying occur.

Water Features

The table "Water Features" gives estimates of several important water features used in land use planning that involves engineering considerations. These features are described in the following paragraphs.

Hydrologic soil groups are groups of soils that, when saturated, have the same runoff potential under similar storm and ground cover conditions. The soil properties that affect the runoff potential are those that influence the minimum rate of infiltration in a bare soil after prolonged wetting and when the soil is not frozen. These properties include the depth to a seasonal high water table, the infiltration rate, permeability after prolonged wetting, and the depth to a very slowly permeable layer. The influences of ground cover and slope are treated independently and are not taken into account in hydrologic soil groups.

In the definitions of the hydrologic soil groups, the infiltration rate is the rate at which water enters the soil at the surface and is controlled by surface conditions. The transmission rate is the rate at which water moves through the soil and is controlled by properties of the soil layers.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of very deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have a moderately fine to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils that have a moderately fine or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clayey soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a clay pan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in the table, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflow from streams or by runoff from adjacent slopes. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in marshes and swamps or in closed depressions is considered to be ponding.

The table "Water Features" gives the frequency and duration of flooding and the time of year when flooding is most likely to occur. Frequency, duration, and probable dates of occurrence are estimated. Frequency generally is expressed as none, rare, occasional, or frequent. *None* means flooding is not probable; *rare* that it is unlikely but is possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is 50 percent in any year).

Duration is expressed as *very brief* (less than 2 days), *brief* (2 to 7 days), *long* (7 to 30 days), and *very long* (more than 30 days). The time of year that flooding is most likely to occur is expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information on flooding is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and level of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is a zone of saturation at the highest average depth during the wettest season. It is at least 6 inches thick, persists in the soil for more than a few weeks, and is within 6 feet of the surface. Indicated in the table "Water Features" are the depth to the seasonal high water table, the kind of water table, and the months of the year when the water table usually is highest.

An *apparent* water table is indicated by the level at which water stands in a freshly dug, unlined borehole after adequate time for adjustments in the surrounding soil.

A *perched* water table is one that is above an unsaturated zone in the soil. The basis for determining that a water table is perched may be general knowledge of the area. The water table is proven to be perched if the water level in a borehole is observed to fall when the borehole is extended.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. "More than 6.0" indicates that the water table is below a depth of 6 feet or that it is within a depth of 6 feet for less than a month.

Ponding is standing water in a closed depression. Unless a drainage system is installed, the water is removed only by percolation, transpiration, or evaporation. The maximum depth refers to the depth of the water above the surface of the soil.

Soil Features

The table "Soil Features" gives estimates of several important soil features used in land use planning that involves engineering considerations. These features are described in the following paragraphs.

Depth to bedrock is given if bedrock is within a depth of 60 inches. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. The table "Soil Features" shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

A *low* potential for frost action indicates that the soil is rarely susceptible to the formation of ice lenses; a *moderate* potential indicates that the soil is susceptible to formation of ice lenses, resulting in frost heave and the subsequent loss of soil strength; and a *high* potential indicates that the soil is highly susceptible to formation of ice lenses, resulting in frost heave and the subsequent loss of soil strength.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate content, texture, moisture content, and acidity of the soil.

Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Properties

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
8B:												
Sparta----------	0-16	Loamy sand-----	SM	A-2, A-4	0	0	85-100	85-100	35-95	15-50	0-14	NP
	16-29	Loamy fine sand, fine sand, sand.	SP-SM, SM	A-2, A-3, A-4	0	0	85-100	85-100	50-95	5-50	0-14	NP
	29-60	Sand, fine sand	SP-SM, SM, SP	A-2, A-3	0	0	85-100	85-100	50-95	2-30	0-14	NP
8C:												
Sparta----------	0-7	Loamy sand-----	SM	A-2, A-4	0	0	85-100	85-100	35-95	15-50	0-14	NP
	7-13	Loamy fine sand, fine sand, sand.	SP-SM, SM	A-2, A-3, A-4	0	0	85-100	85-100	50-95	5-50	0-14	NP
	13-60	Sand, fine sand	SP-SM, SM, SP	A-2, A-3	0	0	85-100	85-100	50-95	2-30	0-14	NP
8D:												
Sparta----------	0-9	Loamy sand-----	SM	A-2, A-4	0	0	85-100	85-100	35-95	15-50	0-14	NP
	9-40	Loamy fine sand, fine sand, sand.	SP-SM, SM	A-2, A-3, A-4	0	0	85-100	85-100	50-95	5-50	0-14	NP
	40-60	Sand, fine sand	SP-SM, SM, SP	A-2, A-3	0	0	85-100	85-100	50-95	2-30	0-14	NP
35:												
Blue Earth------	0-8	Mucky silt loam	OL, ML	A-5	0	0	95-100	95-100	85-95	80-95	41-50	2-8
	8-60	Mucky silty clay loam, clay loam, mucky silt loam.	OL, ML	A-5	0	0	95-100	80-100	80-95	80-95	41-50	2-8
39A:												
Wadena----------	0-13	Loam-----------	ML	A-4	0	0	95-100	90-100	75-95	50-65	25-40	2-10
	13-29	Loam, sandy loam, sandy clay loam.	SM, ML, CL, SC	A-4, A-6	0	0	95-100	80-100	75-95	40-60	25-40	5-12
	29-60	Stratified sand to gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1, A-3, A-2	0-3	0-5	45-100	35-100	10-80	2-10	---	NP

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
41A:												
Estherville-----	0-12	Sandy loam-----	SM, SC-SM, SC	A-2, A-4	0	0-5	90-100	80-100	50-75	25-50	20-30	2-10
	12-15	Sandy loam, loam, coarse sandy loam.	SM, SC-SM, SC	A-2, A-4, A-1	0	0-5	85-100	80-95	40-75	15-45	20-30	2-8
	15-60	Coarse sand, gravelly coarse sand, loamy coarse sand.	SP, SP-SM, SM, GP	A-1	0	0-10	55-90	50-85	10-40	2-25	0-14	NP
85:												
Calco-----------	0-22	Silty clay loam	CH, CL	A-7	0	0	100	100	95-100	85-100	40-60	15-30
	22-60	Silty clay loam	CL, CH	A-7	0	0	100	100	95-100	85-100	40-60	15-30
86:												
Canisteo--------	0-18	Clay loam------	OL, CL	A-7	0	0	95-100	95-100	85-100	60-100	40-50	15-20
	18-26	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	0	98-100	90-100	85-100	65-95	38-50	25-35
	26-33	Clay loam, loam	CL, ML	A-6	0	0-5	90-100	80-95	60-95	50-85	30-40	5-15
	33-60	Clay loam, loam	CL	A-6	0	0-5	95-100	90-98	80-95	50-75	30-40	12-20
96B:												
Collinwood------	0-8	Silty clay loam	CL, CH, ML, MH	A-7	0	0	100	100	95-100	90-95	40-55	15-25
	8-32	Silty clay, clay, silty clay loam.	MH, CH	A-7	0	0	100	100	95-100	90-95	50-65	20-35
	32-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	0	100	100	95-100	90-95	40-60	15-30
101B:												
Truman----------	0-14	Silt loam------	ML, CL-ML, CL	A-4, A-6	0	0	100	100	95-100	80-100	25-40	5-15
	14-40	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	0	100	100	95-100	80-100	25-45	5-20
	40-60	Silt loam------	CL, CL-ML, ML	A-4, A-6	0	0	100	100	95-100	75-95	25-40	5-15
102B:												
Clarion---------	0-12	Loam-----------	CL, CL-ML	A-4, A-6	0	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	12-27	Loam, sandy loam.	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	27-60	Loam, clay loam	CL, CL-ML, SC, SC-SM	A-4, A-6	0	0-5	90-100	85-98	70-85	50-75	25-40	5-15

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
106C2:												
Lester----------	0-9	Loam-----------	ML, CL, CL-ML	A-6, A-4	0	0-5	95-100	90-100	80-95	50-85	30-40	11-15
	9-27	Clay loam, loam	CL	A-6	0-1	0-5	95-100	90-100	80-95	55-75	35-40	15-20
	27-60	Loam, clay loam	CL, CL-ML	A-6	0-1	0-5	95-100	90-100	75-90	50-70	32-39	13-18
112:												
Harps-----------	0-19	Clay loam------	CL, CH	A-6, A-7	0	0-5	95-100	95-100	80-90	65-80	35-55	15-35
	19-25	Loam, clay loam	CL, CH	A-6, A-7	0	0-5	95-100	95-100	80-90	65-80	30-60	10-20
	25-60	Loam, clay loam	CL	A-6	0	0-5	90-100	85-98	70-80	50-75	25-35	8-15
113:												
Webster---------	0-17	Clay loam------	CL, CH	A-7, A-6	0	0-5	95-100	95-100	85-95	75-85	35-45	15-25
	17-24	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0	0-5	95-100	95-100	85-95	65-85	35-45	15-25
	24-60	Loam, clay loam	CL, CL-ML, SC	A-6, A-4	0	0-5	95-100	90-100	75-90	40-70	25-35	8-15
114:												
Glencoe---------	0-10	Clay loam------	OL, ML, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	35-45	15-20
	10-34	Silty clay loam, clay loam, loam.	OL, ML, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-45	10-20
	34-80	Loam, clay loam, silty clay loam.	CL, ML	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-45	10-20
129:												
Cylinder--------	0-15	Loam-----------	CL	A-6	0	0	100	90-100	80-100	50-75	30-40	10-20
	15-31	Loam, clay loam	CL, SC	A-6	0	0	95-100	80-100	80-95	45-70	30-40	10-20
	31-60	Gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0	0-10	65-95	65-95	20-55	5-25	0-14	NP
130:												
Nicollet--------	0-16	Clay loam------	ML, CL	A-6, A-7	0-1	0-5	95-100	90-100	85-100	55-85	35-50	10-25
	16-30	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0-1	0-5	95-100	90-100	80-95	55-80	35-50	15-25
	30-60	Loam, clay loam	CL	A-6	0-1	0-5	95-100	90-100	75-90	50-75	30-40	15-25

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
134:												
Okoboji----------	0-8	Silty clay loam	CH	A-7	0	0	100	100	90-100	80-95	50-60	30-35
	8-28	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	90-100	80-95	50-60	30-35
	28-60	Silty clay loam, silty clay.	CH, CL	A-7	0	0	95-100	95-100	90-100	80-95	50-60	30-35
136:												
Madelia----------	0-16	Silty clay loam	ML	A-7	0	0	100	100	100	90-100	40-50	10-20
	16-30	Silty clay loam, silt loam.	CL	A-7, A-6	0	0	100	100	100	90-100	30-50	10-25
	30-60	Silt loam, silty clay loam.	ML, CL	A-6, A-4, A-7	0	0	100	100	100	90-100	30-50	5-25
140:												
Spicer-----------	0-14	Silty clay loam	ML	A-7, A-6	0	0	100	100	95-100	90-100	35-50	10-20
	14-27	Silt loam, silty clay loam.	ML	A-7, A-6	0	0	100	100	95-100	85-100	35-50	10-20
	27-60	Silt loam, silty clay loam.	ML	A-4, A-6	0	0	100	100	95-100	85-100	30-40	5-12
143B:												
Chelsea----------	0-6	Loamy fine sand	SM, SP-SM	A-2-4	0	0	100	100	65-80	10-35	0-14	NP
	6-60	Fine sand, sand, loamy sand.	SP, SM, SP-SM	A-3, A-2-4	0	0	100	100	65-80	3-15	0-14	NP
178:												
Granby-----------	0-13	Fine sandy loam	SM, SC, SC-SM, ML	A-2, A-4	0	0	100	100	60-90	30-60	0-30	NP-10
	13-26	Sand, fine sand, loamy sand.	SP-SM, SM	A-3, A-2, A-1	0	0	100	95-100	45-80	5-35	0-14	NP
	26-60	Sand, fine sand, loamy fine sand.	SP-SM, SM	A-3, A-2, A-1	0	0	100	95-100	45-80	5-35	0-14	NP

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
181:												
Litchfield------	0-20	Loamy fine sand	SM	A-2	0	0	100	100	80-95	15-35	15-20	NP-4
	20-40	Stratified fine sand to very fine sandy loam.	SM	A-2	0	0	100	100	80-95	20-35	15-20	NP-4
	40-60	Loamy fine sand, loamy sand, sand.	SM, SP-SM	A-2, A-3	0	0	100	100	70-95	5-30	15-20	NP-4
183:												
Dassel----------	0-23	Mucky fine sandy loam.	OL, ML	A-4	0	0	100	95-100	70-85	50-65	15-30	NP-4
	23-31	Stratified loamy fine sand to fine sandy loam.	SM	A-4, A-2	0	0	100	95-100	55-80	25-50	15-30	NP-4
	31-60	Stratified loamy sand to coarse sand.	SM, SP-SM	A-2	0	0	100	80-100	45-90	10-55	---	NP
197:												
Kingston--------	0-16	Silty clay loam	CL	A-6	0	0	100	100	95-100	85-100	30-40	10-20
	16-25	Silty clay loam, silt loam.	CL, ML, CL-ML	A-6, A-7, A-4	0	0	100	100	95-100	85-100	25-50	6-20
	25-60	Silt loam, silty clay loam.	CL-ML, CL, ML	A-4, A-6, A-7	0	0	100	100	95-100	85-100	25-50	5-20
211:												
Lura------------	0-24	Silty clay-----	CH, OH	A-7	0	0	100	100	95-100	90-100	50-75	25-45
	24-31	Silty clay, clay.	OH, CH	A-7	0	0	100	100	95-100	90-100	50-75	25-45
	31-60	Silty clay, silty clay loam, clay.	CL, CH	A-7	0	0	100	100	95-100	90-100	40-75	15-45
229:												
Waldorf---------	0-8	Silty clay loam	ML, MH	A-7	0	0	100	100	95-100	90-100	45-65	14-30
	8-35	Silty clay, silty clay loam.	MH	A-7	0	0	100	100	95-100	95-100	50-70	20-35
	35-60	Silty clay loam, silty clay, silt loam.	MH, CL, ML, CH	A-7, A-6	0	0	100	100	95-100	90-100	35-65	11-30

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
239:												
Le Sueur--------	0-14	Clay loam------	CL, ML	A-6, A-7	0	0	95-100	95-100	90-100	75-90	35-50	10-25
	14-33	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	0	95-100	95-100	85-100	60-80	35-50	15-25
	33-60	Loam, clay loam	CL-ML, CL	A-6, A-4	0-1	0-5	95-100	90-100	80-95	55-75	20-40	5-20
281:												
Darfur----------	0-23	Loam-----------	OL, ML	A-4	0	0	100	100	100	60-80	25-40	NP-10
	23-30	Fine sandy loam, loam, loamy fine sand.	SM	A-4	0	0	100	100	70-100	35-50	20-30	NP-5
	30-60	Stratified fine sand to fine sandy loam.	SM	A-2, A-4	0	0	100	100	50-100	15-40	---	NP
286B:												
Shorewood-------	0-12	Silty clay loam	CL, ML	A-6, A-7	0	0	100	100	90-100	85-100	35-50	12-20
	12-38	Silty clay, silty clay loam.	MH, CH	A-7	0	0	100	100	90-100	85-100	55-75	20-40
	38-60	Clay loam, silty clay loam, silty clay.	CL, ML, CH	A-6, A-7	0	0-5	95-100	90-100	75-100	60-95	35-50	10-20
311C2:												
Shorewood-------	0-6	Silty clay-----	MH	A-7	0	0	100	100	90-100	85-100	50-70	15-25
	6-20	Silty clay, silty clay loam.	MH, CH	A-7	0	0	100	100	90-100	85-100	55-75	20-40
	20-60	Clay loam, silty clay loam, silty clay.	CL, ML, CH	A-6, A-7	0	0-5	95-100	90-100	75-100	60-95	35-50	10-20

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
327A:												
Dickman---------	0-12	Sandy loam-----	SM, SC-SM, SC	A-2, A-4	0	0	95-100	95-100	55-95	25-40	20-30	2-8
	12-18	Sandy loam, fine sandy loam, loamy sand.	SM, SC-SM, SC	A-2, A-4	0	0	95-100	85-100	55-95	25-45	15-25	2-8
	18-60	Fine sand, coarse sand, sand.	SP-SM	A-3, A-2	0	0	95-100	75-100	50-80	5-10	0-14	NP
327B:												
Dickman---------	0-12	Sandy loam-----	SM, SC-SM, SC	A-2, A-4	0	0	95-100	95-100	55-95	25-40	20-30	2-8
	12-30	Sandy loam, fine sandy loam, loamy sand.	SM, SC-SM, SC	A-2, A-4	0	0	95-100	85-100	55-95	25-45	15-25	2-8
	30-60	Fine sand, coarse sand, sand.	SP-SM	A-3, A-2	0	0	95-100	75-100	50-80	5-10	0-14	NP
399:												
Biscay----------	0-14	Loam-----------	CL, ML	A-7, A-6	0	0	95-100	95-100	70-90	50-75	35-50	10-25
	14-25	Loam, clay loam, sandy clay loam.	CL, ML	A-6, A-7	0	0	95-100	90-100	70-90	50-75	30-50	10-20
	25-60	Stratified loamy sand to gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	0	0-5	45-95	35-95	20-45	2-10	---	NP
415:												
Kanaranzi-------	0-9	Loam-----------	ML, CL, CL-ML	A-4, A-6	0	0	95-100	90-100	80-95	60-85	20-40	3-15
	9-18	Loam, clay loam, coarse sandy loam.	CL, ML, CL-ML	A-4, A-6	0	0	95-100	90-100	80-95	60-85	20-40	3-15
	18-60	Gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	0	0-5	50-90	40-85	20-50	0-15	0-25	NP-5
423:												
Seaforth--------	0-12	Loam-----------	ML, CL	A-6	0	0-5	95-100	90-97	80-95	60-80	30-38	11-18
	12-28	Loam, clay loam	CL	A-6	0	0-5	90-100	90-97	80-95	55-80	30-39	11-18
	28-60	Loam-----------	CL	A-6	0	0-5	90-100	90-95	80-90	55-80	30-36	11-15

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
461B:												
Koronis----------	0-8	Loam------------	CL-ML, CL	A-4, A-6	0-1	0-5	85-100	80-95	75-90	50-70	25-35	5-14
	8-31	Sandy clay loam, loam, fine sandy loam.	SC, CL	A-6	0-1	0-5	85-100	80-95	70-90	35-70	30-40	10-20
	31-60	Sandy loam, fine sandy loam, loam.	SC-SM, SC	A-4, A-2	0-2	0-5	85-100	80-95	50-85	25-50	20-30	5-10
461C2:												
Koronis----------	0-8	Loam------------	CL-ML, CL	A-4, A-6	0-1	0-5	85-100	80-95	75-90	50-70	25-35	5-14
	8-24	Sandy clay loam, loam, fine sandy loam.	SC, CL	A-6	0-1	0-5	85-100	80-95	70-90	35-70	30-40	10-20
	24-60	Sandy loam, fine sandy loam, loam.	SC-SM, SC	A-4, A-2	0-2	0-5	85-100	80-95	50-85	25-50	20-30	5-10
511:												
Marcellon--------	0-13	Loam------------	CL, CL-ML, SC, SC-SM	A-4, A-6	0	0-5	85-100	75-100	55-95	45-80	20-30	6-11
	13-32	Loam, clay loam, sandy clay loam.	CL, SC	A-6, A-2	0	0-9	85-100	75-95	60-95	25-80	30-35	11-14
	32-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM, SC-SM, SC	A-2, A-4, A-1-b	0	0	55-100	50-95	30-85	15-50	18-25	3-8
523:												
Houghton---------	0-7	Muck------------	PT	A-8	0	0	0	0	0	0	---	NP
	7-60	Muck------------	PT	A-8	0	0	0	0	0	0	---	NP
525:												
Muskego----------	0-10	Muck------------	PT	A-8	0	0	0	0	0	0	---	NP
	10-40	Muck------------	PT	A-8	0	0	0	0	0	0	---	NP
	40-60	Coprogenous earth.	OL	A-5	0	0	95-100	95-100	85-100	75-96	40-50	2-8

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
539:												
Klossner	0-28	Muck	PT	A-8	0	0	0	0	0	0	---	NP
	28-45	Mucky silt loam, mucky silty clay loam, silt loam.	MH	A-7	0	0	100	95-100	90-100	85-95	60-90	10-30
	45-60	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	0-5	90-100	85-100	60-95	55-80	30-55	10-25
548:												
Medo	0-24	Muck	PT	A-8	0	0	0	0	0	0	---	NP
	24-29	Sandy clay loam, mucky loam, mucky silt loam.	CL-ML, CL, MH	A-7, A-6	0	0	85-100	75-100	55-95	45-85	35-65	7-25
	29-56	Silt loam, sandy loam, silty clay loam.	CL-ML, CL, ML	A-6	0	0	85-100	75-100	55-95	45-85	25-39	7-18
	56-60	Gravelly coarse sand, gravelly loamy coarse sand, fine sand.	SM, SP-SM, SP, GP	A-2, A-4, A-3, A-1	0-2	0-5	75-95	60-95	20-75	2-40	15-25	NP-7
610:												
Calco	0-6	Silty clay loam	CH, CL	A-7	0	0	100	100	95-100	85-100	40-60	15-30
	6-55	Silty clay loam	CL, CH	A-7	0	0	100	100	95-100	85-100	40-60	15-30
	55-60	Silty clay loam, loam, clay loam.	CL	A-7, A-6	0	0	100	100	90-100	80-100	30-45	10-20
611D:												
Hawick	0-7	Gravelly sandy loam.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-35	0-14	NP-4
	7-10	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-25	0-14	NP
	10-60	Gravelly coarse sand, coarse sand, sand.	SP, SP-SM	A-1, A-3, A-2	0-2	0-5	60-95	50-95	30-65	2-10	0-14	NP

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
612B:												
Wadenill	0-13	Loam	CL-ML, CL	A-4, A-6	0-1	0-5	95-100	75-95	75-90	50-70	20-35	4-15
	13-30	Loam, sandy loam, fine sandy loam.	CL, ML, SM, SC	A-4, A-6	0-1	0-5	95-100	75-95	60-85	35-60	20-35	2-12
	30-60	Loam, sandy loam, fine sandy loam.	CL, ML, SM, SC	A-4, A-6	0-2	0-5	95-100	75-95	60-85	35-60	20-35	2-12
613:												
Grovecity	0-15	Loam	CL, ML, CL-ML	A-4, A-6	0-1	0-3	95-100	85-100	65-90	50-70	20-40	2-15
	15-30	Sandy loam, fine sandy loam, loam.	SM, SC, CL, ML	A-4, A-6	0-1	0-3	95-100	85-100	50-85	35-65	15-35	2-13
	30-60	Fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-4, A-6	0-2	0-3	95-100	85-100	50-85	35-65	15-35	NP-15
664:												
Zook	0-10	Silty clay loam	CH, CL	A-7	0	0	100	100	95-100	95-100	45-65	20-35
	10-41	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	95-100	95-100	60-85	35-55
	41-60	Silty clay loam, silty clay, silt loam.	CH, CL, ML, MH	A-7, A-6	0	0	100	100	95-100	95-100	35-80	10-50
740:												
Hamel	0-28	Loam	ML, CL	A-6, A-4	0	0	100	95-100	85-100	60-85	25-40	8-16
	28-56	Clay loam, loam, silty clay loam.	CH, CL	A-7	0	0	95-100	95-100	85-95	65-80	40-55	25-35
	56-60	Loam, clay loam	CL	A-6, A-7	0	0-5	95-100	95-100	80-95	60-80	30-45	10-25
Glencoe	0-15	Loam	OL, ML, CL	A-6	0	0	95-100	90-100	75-100	60-90	30-35	10-15
	15-45	Silty clay loam, clay loam, loam.	OL, ML, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-45	10-20
	45-60	Loam, clay loam, silty clay loam.	CL, ML	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-45	10-20

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
804B:												
Koronis----------	0-8	Loam------------	CL-ML, CL	A-4, A-6	0-1	0-5	85-100	80-95	75-90	50-70	25-35	5-14
	8-33	Sandy clay loam, loam, fine sandy loam.	SC, CL	A-6	0-1	0-5	85-100	80-95	70-90	35-70	30-40	10-20
	33-60	Sandy loam, fine sandy loam, loam.	SC-SM, SC	A-4, A-2	0-2	0-5	85-100	80-95	50-85	25-50	20-30	5-10
Sunburg----------	0-9	Sandy loam------	SC, SM, SC-SM	A-4, A-2	0-1	0-5	85-95	75-95	50-80	30-50	15-30	2-10
	9-60	Loam, fine sandy loam, sandy loam.	CL, ML, SC, SM	A-4, A-6, A-2	0-2	0-5	85-95	75-95	50-85	25-60	15-33	3-12
Hawick-----------	0-9	Gravelly loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-35	0-14	NP-4
	9-49	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-25	0-14	NP
	49-60	Gravelly coarse sand, coarse sand, sand.	SP, SP-SM	A-1, A-3, A-2	0-2	0-5	60-95	50-95	30-65	2-10	0-14	NP
804C2:												
Koronis----------	0-8	Sandy loam------	SM, SC, SC-SM	A-4, A-2	0-1	0-5	85-100	80-95	50-80	30-50	20-30	3-10
	8-26	Sandy clay loam, loam, fine sandy loam.	SC, CL	A-6	0-1	0-5	85-100	80-95	70-90	35-70	30-40	10-20
	26-60	Sandy loam, fine sandy loam, loam.	SC-SM, SC	A-4, A-2	0-2	0-5	85-100	80-95	50-85	25-50	20-30	5-10
Sunburg----------	0-10	Sandy loam------	SC, SM, SC-SM	A-4, A-2	0-1	0-5	85-95	75-95	50-80	30-50	15-30	2-10
	10-60	Loam, fine sandy loam, sandy loam.	CL, ML, SC, SM	A-4, A-6, A-2	0-2	0-5	85-95	75-95	50-85	25-60	15-33	3-12
Hawick-----------	0-9	Gravelly sand	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-35	0-14	NP-4
	9-60	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-25	0-14	NP

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
804D2:												
Koronis	0-8	Sandy loam	SM, SC, SC-SM	A-4, A-2	0-1	0-5	85-100	80-95	50-80	30-50	20-30	3-10
	8-25	Sandy clay loam, loam, fine sandy loam.	SC, CL	A-6	0-1	0-5	85-100	80-95	70-90	35-70	30-40	10-20
	25-60	Sandy loam, fine sandy loam, loam.	SC-SM, SC	A-4, A-2	0-2	0-5	85-100	80-95	50-85	25-50	20-30	5-10
Sunburg	0-7	Sandy loam	SC, SM, SC-SM	A-4, A-2	0-1	0-5	85-95	75-95	50-80	30-50	15-30	2-10
	7-60	Loam, fine sandy loam, sandy loam.	CL, ML, SC, SM	A-4, A-6, A-2	0-2	0-5	85-95	75-95	50-85	25-60	15-33	3-12
Hawick	0-7	Gravelly sandy loam.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-35	0-14	NP-4
	7-20	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-25	0-14	NP
	20-60	Gravelly coarse sand, coarse sand, sand.	SP, SP-SM	A-1, A-3, A-2	0-2	0-5	60-95	50-95	30-65	2-10	0-14	NP
804E:												
Koronis	0-5	Fine sandy loam	SM, SC, SC-SM	A-4, A-2	0-1	0-5	85-100	80-95	50-80	30-50	20-30	3-10
	5-21	Sandy clay loam, loam, fine sandy loam.	SC, CL	A-6	0-1	0-5	85-100	80-95	70-90	35-70	30-40	10-20
	21-60	Sandy loam, fine sandy loam, loam.	SC-SM, SC	A-4, A-2	0-2	0-5	85-100	80-95	50-85	25-50	20-30	5-10
Sunburg	0-4	Fine sandy loam	SC, SM, SC-SM	A-4, A-2	0-1	0-5	85-95	75-95	50-80	30-50	15-30	2-10
	4-60	Loam, fine sandy loam, sandy loam.	CL, ML, SC, SM	A-4, A-6, A-2	0-2	0-5	85-95	75-95	50-85	25-60	15-33	3-12

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
804E:												
Hawick----------	0-14	Gravelly loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-35	0-14	NP-4
	14-60	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-25	0-14	NP
805C2:												
Sunburg---------	0-8	Sandy loam-----	SC, SM, SC-SM	A-4, A-2	0-1	0-5	85-95	75-95	50-80	30-50	15-30	2-10
	8-60	Loam, fine sandy loam, sandy loam.	CL, ML, SC, SM	A-4, A-6, A-2	0-2	0-5	85-95	75-95	50-85	25-60	15-33	3-12
Wadenill--------	0-7	Loam-----------	CL-ML, CL	A-4, A-6	0-1	0-5	95-100	75-95	75-90	50-70	20-35	4-15
	7-20	Loam, sandy loam, fine sandy loam.	CL, ML, SM, SC	A-4, A-6	0-1	0-5	95-100	75-95	60-85	35-60	20-35	2-12
	20-60	Loam, sandy loam, fine sandy loam.	CL, ML, SM, SC	A-4, A-6	0-2	0-5	95-100	75-95	60-85	35-60	20-35	2-12
805D2:												
Sunburg---------	0-7	Sandy loam-----	SC, SM, SC-SM	A-4, A-2	0-1	0-5	85-95	75-95	50-80	30-50	15-30	2-10
	7-60	Loam, fine sandy loam, sandy loam.	CL, ML, SC, SM	A-4, A-6, A-2	0-2	0-5	85-95	75-95	50-85	25-60	15-33	3-12
Wadenill--------	0-7	Loam-----------	CL-ML, CL	A-4, A-6	0-1	0-5	95-100	75-95	75-90	50-70	20-35	4-15
	7-18	Loam, sandy loam, fine sandy loam.	CL, ML, SM, SC	A-4, A-6	0-1	0-5	95-100	75-95	60-85	35-60	20-35	2-12
	18-60	Loam, sandy loam, fine sandy loam.	CL, ML, SM, SC	A-4, A-6	0-2	0-5	95-100	75-95	60-85	35-60	20-35	2-12

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
807D2:												
Koronis----------	0-9	Sandy loam-----	SM, SC, SC-SM	A-4, A-2	0-1	0-5	85-100	80-95	50-80	30-50	20-30	3-10
	9-25	Sandy clay loam, loam, fine sandy loam.	SC, CL	A-6	0-1	0-5	85-100	80-95	70-90	35-70	30-40	10-20
	25-60	Sandy loam, fine sandy loam, loam.	SC-SM, SC	A-4, A-2	0-2	0-5	85-100	80-95	50-85	25-50	20-30	5-10
Sunburg----------	0-7	Sandy loam-----	SC, SM, SC-SM	A-4, A-2	0-1	0-5	85-95	75-95	50-80	30-50	15-30	2-10
	7-60	Loam, fine sandy loam, sandy loam.	CL, ML, SC, SM	A-4, A-6, A-2	0-2	0-5	85-95	75-95	50-85	25-60	15-33	3-12
875B:												
Estherville------	0-9	Sandy loam-----	SM, SC-SM, SC	A-2, A-4	0	0-5	90-100	80-100	50-75	25-50	20-30	2-10
	9-14	Sandy loam, loam, coarse sandy loam.	SM, SC-SM, SC	A-2, A-4, A-1	0	0-5	85-100	80-95	40-75	15-45	20-30	2-8
	14-60	Coarse sand, gravelly coarse sand, loamy coarse sand.	SP, SP-SM, SM, GP	A-1	0	0-10	55-90	50-85	10-40	2-25	0-14	NP
Hawick-----------	0-7	Sandy loam-----	SM	A-2	0-2	0-5	85-100	80-95	50-65	25-35	0-20	NP-4
	7-11	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-25	0-14	NP
	11-60	Gravelly coarse sand, coarse sand, sand.	SP, SP-SM	A-1, A-3, A-2	0-2	0-5	60-95	50-95	30-65	2-10	0-14	NP
875C:												
Hawick-----------	0-11	Gravelly sandy loam.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-35	0-14	NP-4
	11-60	Gravelly coarse sand, coarse sand, sand.	SP, SP-SM	A-1, A-3, A-2	0-2	0-5	60-95	50-95	30-65	2-10	0-14	NP

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
875C:												
Estherville-----	0-8	Sandy loam-----	SM, SC-SM, SC	A-2, A-4	0	0-5	90-100	80-100	50-75	25-50	20-30	2-10
	8-13	Sandy loam, loam, coarse sandy loam.	SM, SC-SM, SC	A-2, A-4, A-1	0	0-5	85-100	80-95	40-75	15-45	20-30	2-8
	13-60	Coarse sand, gravelly coarse sand, loamy coarse sand.	SP, SP-SM, SM, GP	A-1	0	0-10	55-90	50-85	10-40	2-25	0-14	NP
887B:												
Clarion---------	0-11	Loam-----------	CL, CL-ML	A-4, A-6	0	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	11-30	Loam, sandy loam.	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	30-60	Loam, clay loam	CL, CL-ML, SC, SC-SM	A-4, A-6	0	0-5	90-100	85-98	70-85	50-75	25-40	5-15
Swanlake--------	0-8	Loam-----------	CL, ML	A-6	0	0-5	90-100	85-98	75-90	50-70	28-36	9-15
	8-12	Loam, clay loam	CL	A-6	0	0-5	90-100	85-98	70-90	50-70	28-39	9-18
	12-60	Loam, clay loam	CL	A-6	0	0-5	90-100	85-98	75-90	50-75	28-39	9-18
899:												
Harps-----------	0-9	Clay loam------	CL, CH	A-6, A-7	0	0-5	95-100	95-100	80-90	65-80	35-55	15-35
	9-28	Loam, clay loam	CL, CH	A-6, A-7	0	0-5	95-100	95-100	80-90	65-80	30-60	10-20
	28-60	Loam, clay loam	CL	A-6	0	0-5	90-100	85-98	70-80	50-75	25-35	8-15
Okoboji---------	0-17	Silty clay loam	CH	A-7	0	0	100	100	90-100	80-95	50-60	30-35
	17-47	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	90-100	80-95	50-60	30-35
	47-60	Silty clay loam, silty clay.	CH, CL	A-7	0	0	95-100	95-100	90-100	80-95	50-60	30-35
909C2:												
Bold------------	0-7	Silt loam------	ML, CL, CL-ML	A-4, A-6	0	0	100	100	100	90-100	20-35	3-15
	7-60	Silt loam------	ML, CL, CL-ML	A-4, A-6	0	0	100	100	100	90-100	20-35	3-15
Truman----------	0-10	Silt loam------	ML, CL-ML, CL	A-4, A-6	0	0	100	100	95-100	80-100	25-40	5-15
	10-31	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	0	100	100	95-100	80-100	25-45	5-20
	31-60	Silt loam------	CL, CL-ML, ML	A-4, A-6	0	0	100	100	95-100	75-95	25-40	5-15

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
909D2:												
Bold	0-7	Silt loam	ML, CL, CL-ML	A-4, A-6	0	0	100	100	100	90-100	20-35	3-15
	7-60	Silt loam	ML, CL, CL-ML	A-4, A-6	0	0	100	100	100	90-100	20-35	3-15
Truman	0-13	Silt loam	ML, CL-ML, CL	A-4, A-6	0	0	100	100	95-100	80-100	25-40	5-15
	13-22	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	0	100	100	95-100	80-100	25-45	5-20
	22-60	Silt loam	CL, CL-ML, ML	A-4, A-6	0	0	100	100	95-100	75-95	25-40	5-15
920B:												
Clarion	0-12	Loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	12-23	Loam, sandy loam.	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	23-60	Loam, clay loam	CL, CL-ML, SC, SC-SM	A-4, A-6	0	0-5	90-100	85-98	70-85	50-75	25-40	5-15
Storden	0-7	Loam	CL	A-6	0	0-5	95-100	95-98	75-95	60-75	28-36	9-15
	7-37	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
	37-60	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
Hawick	0-9	Gravelly sandy loam.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-35	0-14	NP-4
	9-28	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-25	0-14	NP
	28-60	Gravelly coarse sand, coarse sand, sand.	SP, SP-SM	A-1, A-3, A-2	0-2	0-5	60-95	50-95	30-65	2-10	0-14	NP
945D2:												
Lester	0-9	Loam	ML, CL, CL-ML	A-6, A-4	0	0-5	95-100	90-100	80-95	50-85	30-40	11-15
	9-26	Clay loam, loam	CL	A-6	0-1	0-5	95-100	90-100	80-95	55-75	35-40	15-20
	26-60	Loam, clay loam	CL, CL-ML	A-6	0-1	0-5	95-100	90-100	75-90	50-70	32-39	13-18
Storden	0-5	Loam	CL	A-6	0	0-5	95-100	95-98	75-95	60-75	28-36	9-15
	5-28	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
	28-60	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
945E:												
Lester	0-7	Loam	ML, CL, CL-ML	A-6, A-4	0	0-5	95-100	90-100	80-95	50-85	30-40	11-15
	7-23	Clay loam, loam	CL	A-6	0-1	0-5	95-100	90-100	80-95	55-75	35-40	15-20
	23-60	Loam, clay loam	CL, CL-ML	A-6	0-1	0-5	95-100	90-100	75-90	50-70	32-39	13-18

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
945E:												
Storden----------	0-9	Loam-----------	CL	A-6	0	0-5	95-100	95-98	75-95	60-75	28-36	9-15
	9-30	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
	30-60	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
956:												
Canisteo---------	0-17	Clay loam------	OL, CL	A-7	0	0	95-100	95-100	85-100	60-100	40-50	15-20
	17-23	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	0	98-100	90-100	85-100	65-95	38-50	25-35
	23-41	Clay loam, loam	CL, ML	A-6	0	0-5	90-100	80-95	60-95	50-85	30-40	5-15
	41-60	Clay loam, loam	CL	A-6	0	0-5	95-100	90-98	80-95	50-75	30-40	12-20
Glencoe----------	0-7	Clay loam------	OL, ML, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	35-45	15-20
	7-36	Silty clay loam, clay loam, loam.	OL, ML, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-45	10-20
	36-60	Loam, clay loam, silty clay loam.	CL, ML	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-45	10-20
960C2:												
Storden----------	0-8	Loam-----------	CL	A-6	0	0-5	95-100	95-98	75-95	60-75	28-36	9-15
	8-21	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
	21-60	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
Omsrud-----------	0-9	Loam-----------	CL, ML	A-6, A-2-6	0	0-5	95-100	90-98	85-95	55-75	30-35	11-15
	9-25	Loam, clay loam	CL, ML	A-6, A-2-6	0	0-5	90-100	85-98	75-95	55-80	32-39	13-18
	25-60	Loam, clay loam	CL, ML	A-6, A-2-6	0	0-5	90-100	85-98	75-95	55-85	32-39	13-18
960D2:												
Storden----------	0-7	Loam-----------	CL	A-6	0	0-5	95-100	95-98	75-95	60-75	28-36	9-15
	7-23	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
	23-60	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
Omsrud-----------	0-8	Loam-----------	CL, ML	A-6, A-2-6	0	0-5	95-100	90-98	85-95	55-75	30-35	11-15
	8-22	Loam, clay loam	CL, ML	A-6, A-2-6	0	0-5	90-100	85-98	75-95	55-80	32-39	13-18
	22-60	Loam, clay loam	CL, ML	A-6, A-2-6	0	0-5	90-100	85-98	75-95	55-85	32-39	13-18
978:												
Cordova----------	0-15	Clay loam------	CL, ML, MH, OH	A-6, A-7	0	0	95-100	95-100	90-100	70-85	38-60	12-25
	15-39	Silty clay loam, clay loam.	CL	A-7	0	0	90-100	90-100	85-95	65-90	40-50	20-30
	39-60	Clay loam, loam	CL	A-6	0	0-5	90-100	90-100	80-95	55-70	30-40	12-20

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
978:												
Rolfe-----------	0-28	Silt loam------	OL, CL, ML	A-6, A-4	0	0	100	95-100	90-100	80-95	30-40	5-15
	28-40	Clay, silty clay, clay loam.	CH	A-7	0	0	100	95-100	90-100	75-95	50-65	25-35
	40-60	Clay loam, loam	CL	A-7, A-6	0	0	95-100	90-100	80-90	55-75	30-45	10-20
1015:												
Udipsamments----	0-14	Sand-----------	SM, SP-SM	A-2	0	0	95-100	85-100	75-90	10-35	---	NP
	14-60	Sand, fine sand	SP-SM, SP	A-2, A-3	0	0	95-100	85-100	50-75	5-25	---	NP
	60-80	Coarse sand, gravelly coarse sand.	SP, SP-SM, GP-GM	A-1, A-2	0	0	75-100	65-85	40-65	1-10	---	NP
1016:												
Udorthents------	0-60	Loam-----------	ML, SM, SC-SM, CL-ML	A-4, A-6	0	0-10	95-100	90-100	65-95	35-75	0-30	NP-15
	60-80	Variable-------	---	---	0	0	0	0	0	0	---	NP
1030:												
Pits, gravel.												
Udipsamments----	0-14	Sand-----------	SM, SP-SM	A-2	0	0	95-100	85-100	75-90	10-35	---	NP
	14-60	Sand, fine sand	SP-SM, SP	A-2, A-3	0	0	95-100	85-100	50-75	5-25	---	NP
	60-80	Coarse sand, gravelly coarse sand.	SP, SP-SM, GP-GM	A-1, A-2	0	0	75-100	65-85	40-65	1-10	---	NP
1080:												
Klossner--------	0-25	Muck-----------	PT	A-8	0	0	0	0	0	0	0-14	NP
	25-60	Clay loam, loam, mucky silty clay loam.	CL-ML, CL	A-4, A-6, A-7	0	0	90-100	85-100	80-100	60-90	25-55	10-30
Okoboji---------	0-10	Mucky silty clay loam.	MH	A-7	0	0	100	100	95-100	90-95	60-90	10-30
	10-42	Silty clay loam, silty clay.	CH	A-7	0	0	100	100	90-100	80-95	55-65	30-40
	42-60	Silty clay loam, silty clay.	CH	A-7	0	0	95-100	95-100	90-100	80-95	55-65	30-40

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1080:												
Glencoe----------	0-42	Silty clay loam	OL, OH, MH, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-55	10-25
	42-50	Loam, clay loam, silty clay loam.	MH, CL	A-6, A-7	0	0	95-100	90-100	75-100	60-90	30-50	10-25
	50-60	Loam, clay loam	CL, ML	A-6, A-7	0	0	90-100	85-100	60-95	55-75	30-50	10-20
1096:												
Fieldon----------	0-20	Loam------------	CL-ML, CL, ML	A-4	0	0	100	100	85-95	50-75	20-35	NP-10
	20-26	Fine sandy loam, very fine sandy loam, loam.	ML, SM	A-4	0	0	100	100	70-90	35-60	15-30	NP-5
	26-60	Stratified fine sand to fine sandy loam.	SM	A-2, A-4	0	0	100	100	60-100	15-40	---	NP
Dassel-----------	0-21	Loam------------	OL, ML	A-4	0	0	100	95-100	70-85	50-65	15-30	NP-4
	21-32	Stratified loamy fine sand to fine sandy loam.	SM	A-4, A-2	0	0	100	95-100	55-80	25-50	15-30	NP-4
	32-60	Stratified loamy sand to coarse sand.	SM, SP-SM	A-2	0	0	100	80-100	45-90	10-55	---	NP
1097:												
Mayer------------	0-16	Loam------------	CL, ML	A-6, A-4	0	0-2	95-100	85-100	70-90	50-85	30-40	5-20
	16-25	Sandy clay loam, silt loam, clay loam.	CL, SC, ML, SM	A-6, A-4	0	0-10	65-95	45-85	20-45	2-10	30-40	5-15
	25-60	Gravelly coarse sand, sand, coarse sand.	SP, SW, SP-SM	A-1	0-1	0-10	65-95	45-85	20-45	2-10	15-20	NP

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1097: Biscay----------	0-20	Clay loam------	CL, ML	A-7, A-6	0	0	95-100	95-100	70-90	50-75	35-50	10-25
	20-25	Loam, clay loam, sandy clay loam.	CL, ML	A-6, A-7	0	0	95-100	90-100	70-90	50-75	30-50	10-20
	25-28	Gravelly loam, sandy loam, gravelly sandy loam.	SM, SC-SM, SC	A-4	0	0-5	95-100	70-95	50-80	35-50	15-30	2-10
	28-60	Stratified loamy sand to gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	0	0-5	45-95	35-95	20-45	2-10	---	NP
1098: Biscay----------	0-20	Loam-----------	CL, ML	A-7, A-6	0	0	95-100	95-100	70-95	50-80	35-50	10-25
	20-25	Loam, clay loam, sandy clay loam.	CL, ML	A-6, A-7	0	0	95-100	90-100	70-90	50-75	30-50	10-20
	25-60	Stratified loamy sand to gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	0	0-5	45-95	35-95	20-45	2-10	---	NP
Biscay, depressional---	0-18	Clay loam------	CL, ML	A-7, A-6	0	0	95-100	95-100	70-90	50-75	35-50	10-25
	18-22	Loam, clay loam, sandy clay loam.	CL, ML	A-6, A-7	0	0	95-100	90-100	70-90	50-75	30-50	10-20
	22-26	Gravelly loam, sandy loam, gravelly sandy loam.	SM, SC-SM, SC	A-4	0	0-5	95-100	70-95	50-80	35-50	15-30	2-10
	26-60	Stratified loamy sand to gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	0	0-5	45-95	35-95	20-45	2-10	---	NP
1099: Granby----------	0-12	Loamy fine sand	SM	A-2	0	0	100	100	50-80	15-35	0-14	NP
	12-24	Sand, fine sand, loamy sand.	SP-SM, SM	A-3, A-2, A-1	0	0	100	95-100	45-80	5-35	0-14	NP
	24-60	Coarse sand, fine sand, loamy sand.	SP-SM, SM	A-3, A-2, A-1	0	0	100	95-100	45-80	5-35	0-14	NP

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1100:												
Nicollet----------	0-13	Silty clay loam	ML, CL	A-6, A-7	0-1	0-5	95-100	90-100	85-100	55-85	35-50	10-25
	13-26	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0-1	0-5	95-100	90-100	80-95	55-80	35-50	15-25
	26-60	Loam, clay loam	CL	A-6	0-1	0-5	95-100	90-100	75-90	50-75	30-40	15-25
1101:												
Webster----------	0-19	Silty clay loam	CL, CH	A-7, A-6	0	0-5	95-100	95-100	85-95	80-90	35-45	15-25
	19-24	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0	0-5	95-100	95-100	85-95	65-85	35-45	15-25
	24-60	Loam, clay loam	CL, CL-ML, SC	A-6, A-4	0	0-5	95-100	90-100	75-90	40-70	25-35	8-15
1159B:												
Strout----------	0-10	Clay----------	CL, CH	A-7	0-1	0-2	98-100	95-100	90-100	75-95	45-60	20-35
	10-24	Clay loam, clay	CL, CH	A-7	0-2	0-2	95-100	95-100	90-100	75-95	45-60	20-30
	24-60	Clay loam, clay	CL, CH	A-7	0-2	0-4	95-100	95-100	90-100	70-95	40-55	20-30
Arkton----------	0-9	Clay loam------	CL	A-7	0-1	0-3	95-100	85-100	75-100	65-95	40-50	15-25
	9-25	Clay, silty clay, clay loam.	CH, CL	A-7	0-1	0-3	95-100	85-100	75-100	70-95	40-60	15-35
	25-60	Clay loam, loam	CL, CH	A-6, A-7	0-1	0-3	95-100	85-100	70-100	55-90	35-60	11-30
1161:												
Barry----------	0-11	Loam----------	SC, CL	A-4, A-6	0	2-5	95-98	90-95	60-80	40-70	25-35	8-15
	11-33	Loam, sandy clay loam.	CL	A-6	0	5-7	90-95	85-95	60-80	50-75	28-35	10-15
	33-60	Sandy loam, fine sandy loam.	SC, SC-SM, CL-ML, CL	A-4	0	5-7	90-95	85-95	50-75	35-55	20-25	5-10
1162A:												
Kandiyohi----------	0-11	Clay----------	CH	A-7	0-1	1-2	95-100	95-98	95-98	85-95	55-65	25-40
	11-26	Silty clay, silty clay loam, clay.	CH	A-7	0-1	1-2	95-100	95-98	95-98	85-95	55-70	25-50
	26-33	Clay loam, silty clay, clay.	CH, CL	A-7	0-2	2-4	95-100	95-98	90-95	75-95	50-70	20-45
	33-60	Clay loam, clay	CH, CL	A-7	0-2	2-5	95-100	95-98	80-95	70-95	45-70	20-45

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1162B:												
Kandiyohi--------	0-10	Clay-----------	CH	A-7	0-1	1-2	95-100	95-98	95-98	85-95	55-65	25-40
	10-23	Silty clay, silty clay loam, clay.	CH	A-7	0-1	1-2	95-100	95-98	95-98	85-95	55-70	25-50
	23-29	Clay loam, silty clay, clay.	CH, CL	A-7	0-2	2-4	95-100	95-98	90-95	75-95	50-70	20-45
	29-60	Clay loam, clay	CH, CL	A-7	0-2	2-5	95-100	95-98	80-95	70-95	45-70	20-45
1163:												
Cohoctah-------	0-17	Loam-----------	ML, CL, CL-ML	A-4	0	0	100	100	85-95	50-85	0-30	0-10
	17-22	Loam, fine sandy loam, sandy loam.	ML, SM, SC, CL	A-4, A-2	0	0	95-100	85-100	70-90	30-70	0-30	0-10
	22-60	Coarse sand, sand, loamy fine sand.	SP, SM, SW, SP-SM	A-3, A-2, A-1	0	0-2	90-100	85-100	40-80	2-30	0-25	NP
1165:												
Lundlake--------	0-14	Silty clay loam	OL, ML, CL	A-6, A-7	0-1	0-3	95-99	90-95	65-90	50-80	37-43	16-21
	14-35	Loam, clay loam, silty clay loam.	CL, ML, CL-ML	A-6	0-1	1-3	95-99	90-95	65-90	50-80	30-39	11-18
	35-47	Loam, sandy clay loam, sandy loam.	CL, SC	A-6, A-4	0-1	3-5	90-95	85-95	60-85	45-60	28-36	9-15
	47-60	Sandy loam, fine sandy loam, loam.	CL, SC, SM	A-4	0-2	3-7	85-95	75-95	60-80	35-55	21-26	4-8
1168:												
Swedegrove------	0-15	Loam-----------	CL, SC	A-6, A-4	0-1	1-3	90-98	85-95	70-85	45-75	30-35	10-15
	15-31	Loam, sandy clay loam, fine sandy loam.	CL, SC, SC-SM	A-6, A-4	0-1	3-5	85-95	85-95	60-85	45-65	30-35	5-10
	31-60	Sandy loam, fine sandy loam.	CL-ML, SC-SM, SC	A-4	0-2	3-7	85-95	85-95	60-75	35-55	20-25	5-10

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1168:												
Lundlake---------	0-12	Silty clay loam	OL, ML, CL	A-6, A-7	0-1	0-3	95-99	90-95	65-90	50-80	37-43	16-21
	12-28	Loam, clay loam, silty clay loam.	CL, ML, CL-ML	A-6	0-1	1-3	95-99	90-95	65-90	50-80	30-39	11-18
	28-36	Loam, sandy clay loam, sandy loam.	CL, SC	A-6, A-4	0-1	3-5	90-95	85-95	60-85	45-60	28-36	9-15
	36-60	Sandy loam, fine sandy loam, loam.	CL, SC, SM	A-4	0-2	3-7	85-95	75-95	60-80	35-55	21-26	4-8
1169:												
Corvuso----------	0-11	Clay loam-------	CH, MH	A-7	0-1	0-1	100	95-100	90-100	75-95	50-65	30-45
	11-28	Silty clay, clay, silty clay loam.	CH, MH	A-7	0-1	1-2	100	95-100	90-100	75-95	50-70	30-50
	28-60	Clay loam, clay, silty clay.	CH, CL	A-7	0-2	2-4	95-100	95-98	80-95	70-95	45-70	25-45
Lura-------------	0-26	Silty clay------	CH, OH	A-7	0	0	100	100	95-100	90-100	50-75	25-45
	26-60	Silty clay, clay.	OH, CH	A-7	0	0	100	100	95-100	90-100	50-75	25-45
1171C:												
Newlondon--------	0-7	Clay loam-------	CL, CH	A-7	0-1	0-2	98-100	95-100	90-100	75-95	40-55	20-30
	7-38	Clay loam, clay, silty clay.	CL, CH	A-7	0-2	0-3	95-100	95-100	90-100	70-95	40-55	20-30
	38-60	Clay loam, loam	CL, CH	A-6, A-7	0-1	0-3	95-100	85-100	70-100	55-90	35-55	11-30
Strout-----------	0-9	Clay loam-------	CL, CH	A-7	0-1	0-2	98-100	95-100	90-100	75-95	45-60	20-35
	9-23	Clay loam, clay	CL, CH	A-7	0-2	0-2	95-100	95-100	90-100	75-95	45-60	20-30
	23-60	Clay loam, clay	CL, CH	A-7	0-2	0-4	95-100	95-100	90-100	70-95	40-55	20-30
1171D:												
Newlondon--------	0-7	Clay loam-------	CL, CH	A-7	0-1	0-2	98-100	95-100	90-100	75-95	40-55	20-30
	7-38	Clay loam, clay, silty clay.	CL, CH	A-7	0-2	0-3	95-100	95-100	90-100	70-95	40-55	20-30
	38-60	Clay loam, loam	CL, CH	A-6, A-7	0-1	0-3	95-100	85-100	70-100	55-90	35-55	11-30

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1171D:												
Strout----------	0-9	Clay loam------	CL, CH	A-7	0-1	0-2	98-100	95-100	90-100	75-95	45-60	20-35
	9-19	Clay loam, clay	CL, CH	A-7	0-2	0-2	95-100	95-100	90-100	75-95	45-60	20-30
	19-60	Clay loam, clay	CL, CH	A-7	0-2	0-4	95-100	95-100	90-100	70-95	40-55	20-30
1172C:												
Sparta----------	0-18	Loamy sand-----	SM	A-2, A-4	0	0	85-100	85-100	35-95	15-50	0-14	NP
	18-55	Loamy fine sand, fine sand, sand.	SP-SM, SM	A-2, A-3, A-4	0	0	85-100	85-100	50-95	5-50	0-14	NP
	55-60	Sand, fine sand	SP-SM, SM, SP	A-2, A-3	0	0	85-100	85-100	50-95	2-30	0-14	NP
Gardencity------	0-7	Fine sandy loam	SM	A-2, A-3	0	0	100	100	75-85	40-65	10-35	2-10
	7-24	Stratified fine sand to silt loam.	SM, ML, CL-ML	A-2, A-3, A-4	0	0	100	100	65-100	30-90	10-30	4-10
	24-60	Stratified fine sand to silt loam.	SM, ML, CL-ML	A-2, A-3, A-4	0	0	100	100	65-100	30-90	10-35	4-10
1173:												
Muskego---------	0-45	Muck-----------	PT	A-8	0	0	0	0	0	0	---	NP
	45-60	Coprogenous earth.	PT	A-5	0	0	100	100	95-100	95-100	40-50	2-4
Klossner--------	0-22	Muck-----------	PT	A-8	0	0	0	0	0	0	---	NP
	22-45	Mucky silt loam, mucky silty clay loam.	MH	A-7	0	0	100	95-100	90-100	85-95	60-90	35-65
	45-60	Silt loam, loam, silty clay loam.	CL, ML	A-7, A-6	0	0-5	90-100	85-100	60-100	55-90	35-65	10-25
1174:												
Danielson-------	0-9	Clay loam------	CL, CH	A-7	0-1	0-1	95-100	95-100	80-90	75-90	40-60	20-30
	9-36	Silty clay loam, silty clay.	CH, MH	A-7	0-1	1-2	95-100	95-100	85-95	85-95	45-60	20-35
	36-51	Silty clay loam, silty clay, clay.	CH, MH	A-7	0-1	1-2	95-100	95-100	85-95	85-95	50-65	30-40
	51-60	Silty clay loam, clay loam, clay.	CH, CL	A-7	0-1	2-4	90-95	90-95	70-95	70-95	40-60	20-40

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1175:												
Swedegrove------	0-14	Loam-----------	CL, SC	A-6, A-4	0-1	1-3	90-98	85-95	70-85	45-75	30-35	10-15
	14-20	Loam, sandy clay loam, fine sandy loam.	CL, SC, SC-SM	A-6, A-4	0-1	3-5	85-95	85-95	60-85	45-65	30-35	5-10
	20-60	Sandy loam, fine sandy loam.	CL-ML, SC-SM, SC	A-4	0-2	3-7	85-95	85-95	60-75	35-55	20-25	5-10
1176:												
Litchfield------	0-17	Sandy loam-----	SC-SM, SC	A-2, A-4	0	0	100	100	60-75	30-45	20-25	5-10
	17-33	Loamy sand, loamy fine sand.	SM, SC-SM	A-2	0	0	100	100	50-70	5-15	10-20	NP-5
	33-60	Sand, fine sand	SP-SM, SM	A-2, A-3	0	0	100	100	50-75	5-15	---	NP
1177C:												
Gardencity------	0-13	Fine sandy loam	SM	A-2, A-3	0	0	100	100	75-85	40-65	10-35	2-10
	13-25	Stratified fine sand to silt loam.	SM, ML, CL-ML	A-2, A-3, A-4	0	0	100	100	65-100	30-90	10-30	4-10
	25-60	Stratified fine sand to silt loam.	SM, ML, CL-ML	A-2, A-3, A-4	0	0	100	100	65-100	30-90	10-35	4-10
Bold------------	0-7	Silt loam------	ML, CL, CL-ML	A-4, A-6	0	0	100	100	100	90-100	20-35	3-15
	7-60	Silt loam------	ML, CL, CL-ML	A-4, A-6	0	0	100	100	100	90-100	20-35	3-15
1178:												
Uniongrove------	0-16	Loam-----------	CL	A-6	0-1	1-4	90-98	85-95	70-85	50-75	30-35	10-15
	16-30	Loam, sandy clay loam, fine sandy loam.	CL	A-6, A-4	0-2	4-6	90-98	85-95	60-85	50-70	25-35	10-15
	30-60	Sandy loam, fine sandy loam.	SC, SC-SM, CL-ML	A-4	0-2	4-6	90-95	85-95	60-75	35-55	20-25	5-10

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1183: Crowriver-------	0-15	Loam-----------	SM, SC-SM, SC, CL	A-4, A-6	0-1	1-3	95-99	85-95	65-90	40-60	25-30	7-11
	15-22	Sandy clay loam, loam, fine sandy loam.	SC-SM, SC, CL	A-4, A-6	0-1	1-3	85-95	85-95	65-85	40-60	23-32	6-13
	22-60	Sandy loam, fine sandy loam.	SC, SC-SM, CL-ML	A-4	0-2	3-7	85-95	80-95	60-80	35-55	23-28	6-9
1184: Corvuso---------	0-19	Silty clay loam	CH, MH	A-7	0-1	0-1	100	95-100	90-100	75-95	50-70	30-50
	19-26	Silty clay, clay, silty clay loam.	CH, MH	A-7	0-1	1-2	100	95-100	90-100	75-95	50-70	30-50
	26-60	Clay loam, clay, silty clay.	CH, CL	A-7	0-2	2-4	95-100	95-98	80-95	70-95	45-70	25-45
1185: Gardencity------	0-19	Fine sandy loam	SM	A-2, A-3	0	0	100	100	75-85	40-65	10-35	2-10
	19-24	Stratified fine sand to silt loam.	SM, ML, CL-ML	A-2, A-3, A-4	0	0	100	100	65-100	30-90	10-30	4-10
	24-60	Stratified fine sand to silt loam.	SM, ML, CL-ML	A-2, A-3, A-4	0	0	100	100	65-100	30-90	10-35	4-10
1186: Forestcity------	0-22	Fine sandy loam	SC-SM, SC	A-4, A-2	0-1	0-2	98-100	90-98	55-75	25-50	20-30	4-9
	22-36	Loam, sandy clay loam, clay loam.	CL	A-6	0-4	2-5	95-98	90-95	75-90	50-75	30-40	10-15
	36-60	Loam, sandy clay loam, clay loam.	CL, CL-ML, SC	A-6, A-4	0-4	3-6	95-98	85-95	60-90	35-70	20-40	5-15
	60-65	Fine sandy loam, sandy loam.	SC-SM, SC, CL-ML	A-4	0-4	3-6	90-95	85-95	60-75	35-55	20-30	4-8

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1186:												
Lundlake--------	0-20	Loam-----------	OL, ML, CL, CL-ML	A-6	0-1	1-3	95-99	90-95	65-90	50-80	30-36	11-15
	20-28	Loam, clay loam, silty clay loam.	CL, ML, CL-ML	A-6	0-1	1-3	95-99	90-95	65-90	50-80	30-39	11-18
	28-46	Loam, sandy clay loam, sandy loam.	CL, SC	A-6, A-4	0-1	3-5	90-95	85-95	60-85	45-60	28-36	9-15
	46-60	Sandy loam, fine sandy loam, loam.	CL, SC, SM	A-4	0-2	3-7	85-95	75-95	60-80	35-55	21-26	4-8
1192:												
Crowriver-------	0-13	Fine sandy loam	SM, SC-SM, SC, CL	A-4, A-6	0-1	1-3	95-99	85-95	65-90	40-60	25-30	7-11
	13-17	Sandy clay loam, loam, fine sandy loam.	SC-SM, SC, CL	A-4, A-6	0-1	1-3	85-95	85-95	65-85	40-60	23-32	6-13
	17-60	Sandy loam, fine sandy loam.	SC, SC-SM, CL-ML	A-4	0-2	3-7	85-95	80-95	60-80	35-55	23-28	6-9
Lundlake--------	0-22	Loam-----------	OL, ML, CL, CL-ML	A-6	0-1	1-3	95-99	90-95	65-90	50-80	30-36	11-15
	22-28	Loam, clay loam, silty clay loam.	CL, ML, CL-ML	A-6	0-1	1-3	95-99	90-95	65-90	50-80	30-39	11-18
	28-35	Loam, sandy clay loam, sandy loam.	CL, SC	A-6, A-4	0-1	3-5	90-95	85-95	60-85	45-60	28-36	9-15
	35-60	Sandy loam, fine sandy loam, loam.	CL, SC, SM	A-4	0-2	3-7	85-95	75-95	60-80	35-55	21-26	4-8
1193:												
Cosmos----------	0-15	Silty clay-----	CH, MH	A-7	0-1	0-1	98-100	98-100	95-100	85-95	50-65	30-40
	15-30	Silty clay, silty clay loam, clay.	CH, MH	A-7	0-1	0-2	98-100	98-100	95-100	85-95	50-75	30-50
	30-60	Clay, clay loam, silty clay.	CH, CL	A-7	0-2	0-4	95-100	95-98	90-95	70-95	40-60	18-35

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1197:												
Cohoctah--------	0-21	Fine sandy loam	ML, SM, SC, CL	A-4, A-2	0	0	100	100	60-95	30-65	0-30	NP-10
	21-36	Loam, fine sandy loam, sandy loam.	ML, SM, SC, CL	A-4, A-2	0	0	95-100	85-100	70-90	30-70	0-30	NP-10
	36-60	Loam, sandy loam, loamy fine sand.	ML, SM, SC, CL	A-4, A-2	0	0	95-100	85-100	65-90	20-70	0-30	NP-10
1198B:												
Rohrbeck--------	0-6	Loamy sand-----	SM	A-2	0	0-1	98-100	95-100	70-90	15-35	5-15	NP-2
	6-25	Sand, fine sand, loamy sand.	SM, SP-SM	A-2	0	0-1	98-100	95-100	65-90	10-25	5-15	NP-2
	25-41	Sandy loam, sandy clay loam, loam.	SC, CL, SC-SM	A-4, A-6	0-1	0-5	85-100	80-95	65-90	30-60	25-40	10-15
	41-60	Sandy loam, fine sandy loam.	SC, SC-SM, CL-ML	A-4	0-1	0-5	85-100	80-95	50-85	35-55	20-30	5-10
Koronis---------	0-9	Sandy loam-----	SM, SC, SC-SM	A-4, A-2	0-1	0-5	85-100	80-95	50-80	30-50	20-30	3-10
	9-28	Sandy clay loam, loam, fine sandy loam.	SC, CL	A-6	0-1	0-5	85-100	80-95	70-90	35-70	30-40	10-20
	28-60	Sandy loam, fine sandy loam, loam.	SC-SM, SC	A-4, A-2	0-2	0-5	85-100	80-95	50-85	25-50	20-30	5-10
1199:												
Klossner--------	0-38	Muck-----------	PT	A-8	0	0	0	0	0	0	0-14	NP
	38-60	Clay loam, loam, mucky silty clay loam.	CL-ML, CL	A-4, A-6, A-7	0	0	90-100	85-100	80-100	60-90	25-55	10-30
Lundlake--------	0-26	Mucky loam-----	OL, CL, ML	A-6	0-1	1-3	95-99	90-95	65-90	50-80	30-36	11-15
	26-56	Loam, clay loam, silty clay loam.	CL, ML	A-6	0-1	1-3	95-100	90-100	65-95	50-90	30-36	11-15
	56-60	Sandy loam, loam, fine sandy loam.	CL, CL-ML, SC, SC-SM	A-4, A-2-4	0-2	3-7	85-95	75-95	60-80	35-55	21-26	4-8

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1203:												
Muskego----------	0-10	Muck------------	PT	A-8	0	0	0	0	0	0	---	NP
	10-29	Coprogenous earth.	OL, ML	A-5	0	0	95-100	95-100	85-100	75-96	41-50	2-8
	29-60	Loam, clay loam	CL, ML	A-6, A-7	0	0	94-100	88-100	60-95	55-75	30-50	10-20
Blue Earth------	0-50	Mucky silt loam	OL, ML	A-5	0	0	95-100	95-100	85-95	80-95	41-50	2-8
	50-60	Mucky silty clay loam, clay loam, mucky silt loam.	OL, ML	A-5	0	0	95-100	80-100	80-95	80-95	41-50	2-8
Houghton---------	0-60	Muck------------	PT	A-8	0	0	0	0	0	0	---	NP
1204B:												
Reedslake--------	0-12	Loam------------	CL, CL-ML	A-6	0	0-2	95-100	90-98	80-95	60-75	30-35	10-15
	12-26	Clay loam, loam	CL	A-6, A-7	0	0-5	95-100	90-98	80-95	60-80	32-45	12-25
	26-60	Loam------------	CL, CL-ML	A-6	0	0-5	95-100	90-98	80-95	55-75	30-36	11-15
1213C:												
Cokato-----------	0-16	Loam------------	CL, CL-ML	A-6	0	0-2	95-100	90-98	80-95	60-70	32-36	13-15
	16-41	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	0-5	95-100	90-98	80-95	65-80	34-43	14-21
	41-60	Loam------------	CL, CL-ML	A-6	0	0-5	95-100	90-98	80-95	55-75	30-39	11-18
Storden----------	0-9	Loam------------	CL	A-6	0	0-5	95-100	95-98	75-95	60-75	28-36	9-15
	9-18	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
	18-60	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18
1220C:												
Cokato-----------	0-10	Loam------------	CL, CL-ML	A-6	0	0-2	95-100	90-98	80-95	60-70	32-36	13-15
	10-29	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	0-5	95-100	90-98	80-95	65-80	34-43	14-21
	29-60	Loam------------	CL, CL-ML	A-6	0	0-5	95-100	90-98	80-95	55-75	30-39	11-18
Storden----------	0-9	Loam------------	CL	A-6	0	0-5	95-100	95-98	75-95	60-75	28-36	9-15
	9-60	Loam, clay loam	CL, ML	A-6	0	0-5	95-100	90-98	70-95	55-70	28-39	9-18

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1220C: Hawick----------	0-8	Gravelly sandy loam.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-35	0-14	NP-4
	8-33	Gravelly loamy coarse sand, gravelly coarse sand, loamy sand.	SP-SM, SM	A-1, A-2, A-3	0-2	0-5	75-95	60-95	35-70	5-25	0-14	NP
	33-60	Gravelly coarse sand, coarse sand, sand.	SP, SP-SM	A-1, A-3, A-2	0-2	0-5	60-95	50-95	30-65	2-10	0-14	NP
1362B: Angus-----------	0-9	Loam-----------	CL	A-6	0	0-5	95-100	90-100	80-95	50-85	30-40	11-15
	9-35	Clay loam, loam	CL	A-6	0-1	0-5	95-100	90-100	80-95	55-75	35-40	15-20
	35-60	Loam, clay loam	CL	A-6	0-1	0-5	95-100	90-100	75-90	50-70	32-39	13-18
1383A: Shorewood-------	0-9	Silty clay loam	CL, ML	A-6, A-7	0	0	100	100	90-100	85-100	35-50	12-20
	9-46	Silty clay, silty clay loam.	MH, CH	A-7	0	0	100	100	90-100	85-100	55-75	20-40
	46-60	Clay loam, silty clay loam, silty clay.	CL, ML, CH	A-6, A-7	0	0-5	95-100	90-100	75-100	60-95	35-50	10-20
1384: Minneopa--------	0-7	Loam-----------	CL, CL-ML	A-6	0	0	95-100	85-100	70-95	50-75	20-35	4-13
	7-15	Loam, sandy loam.	SM, ML, CL-ML, SC-SM	A-4, A-2	0	0	90-100	85-100	55-90	25-70	16-28	3-9
	15-25	Loamy sand, gravelly loamy sand, gravelly coarse sand.	SP, SP-SM, GP	A-1	0	0	70-100	50-90	10-55	2-10	---	NP
	25-60	Gravelly loamy sand, gravelly sand, gravelly coarse sand.	SP, SP-SM, SM, GP	A-1	0	0	70-100	50-90	10-40	0-10	---	NP
1385: Havelock--------	0-15	Loam-----------	CL	A-6	0	0	100	95-100	85-95	60-75	30-40	10-20
	15-38	Clay loam, silty clay loam.	CL, CH	A-7	0	0	100	100	95-100	65-85	45-55	20-30
	38-60	Loam, sandy loam, sandy clay loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0	0	100	90-100	60-70	40-60	20-40	5-15

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1387A:												
Collinwood------	0-13	Silty clay loam	CL, CH, ML, MH	A-7	0	0	100	100	95-100	90-95	40-55	15-25
	13-32	Silty clay, clay, silty clay loam.	MH, CH	A-7	0	0	100	100	95-100	90-95	50-65	20-35
	32-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	0	100	100	95-100	90-95	40-60	15-30
1391B:												
Wadenill---------	0-9	Loam-----------	CL-ML, CL	A-4, A-6	0-1	0-5	95-100	75-95	75-90	50-70	20-35	4-15
	9-25	Loam, sandy loam, fine sandy loam.	CL, ML, SM, SC	A-4, A-6	0-1	0-5	95-100	75-95	60-85	35-60	20-35	2-12
	25-60	Loam, sandy loam, fine sandy loam.	CL, ML, SM, SC	A-4, A-6	0-2	0-5	95-100	75-95	60-85	35-60	20-35	2-12
Sunburg----------	0-7	Fine sandy loam	SC, SM, SC-SM	A-4, A-2	0-1	0-5	85-95	75-95	50-80	30-50	15-30	2-10
	7-60	Loam, fine sandy loam, sandy loam.	CL, ML, SC, SM	A-4, A-6, A-2	0-2	0-5	85-95	75-95	50-85	25-60	15-33	3-12
1406:												
Medo-------------	0-20	Muck-----------	PT	A-8	0	0	0	0	0	0	---	NP
	20-28	Sandy clay loam, mucky loam, mucky silt loam.	CL-ML, CL, MH	A-7, A-6	0	0	85-100	75-100	55-95	45-85	35-65	7-25
	28-34	Silt loam, sandy loam, silty clay loam.	CL-ML, CL, ML	A-6	0	0	85-100	75-100	55-95	45-85	25-39	7-18
	34-60	Gravelly coarse sand, gravelly loamy coarse sand, fine sand.	SM, SP-SM, SP, GP	A-2, A-4, A-3, A-1	0-2	0-5	75-95	60-95	20-75	2-40	15-25	NP-7
Dassel-----------	0-14	Fine sandy loam	SM, OL	A-4	0	0	100	95-100	70-85	40-50	15-30	NP-4
	14-31	Stratified loamy fine sand to fine sandy loam.	SM	A-4, A-2	0	0	100	95-100	55-80	25-50	15-30	NP-4
	31-60	Stratified loamy sand to coarse sand.	SM, SP-SM	A-2	0	0	100	80-100	45-90	10-55	---	NP

Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1406:												
Biscay----------	0-10	Mucky loam-----	CL, ML	A-7, A-6	0	0	95-100	95-100	70-90	50-75	35-50	10-25
	10-29	Loam, clay loam, sandy clay loam.	CL, ML	A-6, A-7	0	0	95-100	90-100	70-90	50-75	30-50	10-20
	29-60	Stratified loamy sand to gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	0	0-5	45-95	35-95	20-45	2-10	---	NP
1801B:												
Gardencity------	0-13	Very fine sandy loam.	SM	A-2, A-3	0	0	100	100	75-85	40-65	10-35	2-10
	13-34	Stratified fine sand to silt loam.	SM, ML, CL-ML	A-2, A-3, A-4	0	0	100	100	65-100	30-90	10-30	4-10
	34-60	Stratified fine sand to silt loam.	SM, ML, CL-ML	A-2, A-3, A-4	0	0	100	100	65-100	30-90	10-35	4-10

Physical Properties of the Soils

(Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Wind erodibility index" apply only to the surface layer. Absence of an entry indicates that data were not estimated)

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors			Wind erodi-bility group	Wind erodi-bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
8B:												
Sparta----------	0-16	3-10	1.20-1.40	2.00-6.00	0.09-0.12	Low------	1.0-2.0	0.17	0.17	5	2	134
	16-29	1-8	1.40-1.60	6.00-20.00	0.05-0.11	Low------	0.1-1.0	0.15	0.15			
	29-60	0-5	1.50-1.70	6.00-20.00	0.04-0.07	Low------	0.0-0.5	0.15	0.15			
8C:												
Sparta----------	0-7	3-10	1.20-1.40	2.00-6.00	0.09-0.12	Low------	1.0-2.0	0.17	0.17	5	2	134
	7-13	1-8	1.40-1.60	6.00-20.00	0.05-0.11	Low------	0.1-1.0	0.15	0.15			
	13-60	0-5	1.50-1.70	6.00-20.00	0.04-0.07	Low------	0.0-0.5	0.15	0.15			
8D:												
Sparta----------	0-9	3-10	1.20-1.40	2.00-6.00	0.09-0.12	Low------	1.0-2.0	0.17	0.17	5	2	134
	9-40	1-8	1.40-1.60	6.00-20.00	0.05-0.11	Low------	0.1-1.0	0.15	0.15			
	40-60	0-5	1.50-1.70	6.00-20.00	0.04-0.07	Low------	0.0-0.5	0.15	0.15			
35:												
Blue Earth------	0-8	18-32	0.20-0.80	0.60-2.00	0.18-0.24	Moderate	10-25	0.28	0.28	5	6	48
	8-60	18-32	0.20-0.80	0.60-2.00	0.18-0.24	Low------	10-25	0.28	0.28			
39A:												
Wadena----------	0-13	18-27	1.30-1.50	0.60-2.00	0.20-0.22	Low------	3.0-6.0	0.24	0.24	4	6	48
	13-29	18-30	1.35-1.50	0.60-2.00	0.14-0.19	Low------	0.5-1.0	0.32	0.32			
	29-60	1-5	1.55-1.65	20.0-63.0	0.02-0.04	Low------	0.0-0.5	0.10	0.10			
41A:												
Estherville-----	0-12	5-15	1.25-1.35	2.00-6.00	0.13-0.18	Low------	2.0-4.0	0.20	0.20	3	3	86
	12-15	10-18	1.35-1.60	2.00-6.00	0.13-0.18	Low------	0.0-0.5	0.20	0.20			
	15-60	0-8	1.50-1.65	6.00-63.00	0.02-0.04	Low------	0.0-0.5	0.10	0.10			
85:												
Calco-----------	0-22	28-33	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	5.0-7.0	0.28	0.28	5	4L	86
	22-60	30-35	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	3.0-5.0	0.28	0.28			
86:												
Canisteo--------	0-18	27-35	1.25-1.35	0.60-2.00	0.18-0.22	Moderate	4.0-8.0	0.24	0.24	5	4L	86
	18-26	25-35	1.35-1.50	0.60-2.00	0.15-0.19	Moderate	2.0-4.0	0.32	0.32			
	26-33	25-35	1.30-1.50	0.60-2.00	0.12-0.18	Low------	0.5-1.0	0.32	0.32			
	33-60	22-30	1.45-1.60	0.60-2.00	0.14-0.16	Low------	0.0-0.5	0.32	0.32			
96B:												
Collinwood------	0-8	35-40	1.20-1.30	0.20-0.60	0.14-0.17	Moderate	5.0-7.0	0.32	0.32	5	4	86
	8-32	35-60	1.25-1.35	0.06-0.60	0.13-0.16	High-----	1.0-3.0	0.32	0.32			
	32-60	35-45	1.25-1.40	0.06-0.60	0.11-0.15	High-----	0.0-2.0	0.32	0.32			
101B:												
Truman----------	0-14	18-27	1.25-1.35	0.60-2.00	0.20-0.23	Low------	4.0-8.0	0.32	0.32	5	6	48
	14-40	18-32	1.30-1.45	0.60-2.00	0.18-0.21	Low------	1.0-2.0	0.43	0.43			
	40-60	18-32	1.35-1.45	0.60-2.00	0.18-0.20	Low------	0.0-1.0	0.43	0.43			
102B:												
Clarion---------	0-12	20-27	1.30-1.55	0.60-2.00	0.20-0.22	Low------	3.0-6.0	0.24	0.24	5	6	48
	12-27	23-30	1.30-1.55	0.60-2.00	0.17-0.19	Moderate	0.5-1.0	0.37	0.37			
	27-60	22-30	1.30-1.55	0.60-2.00	0.17-0.19	Moderate	0.0-0.5	0.37	0.37			
106C2:												
Lester----------	0-9	20-27	1.30-1.40	0.60-2.00	0.20-0.22	Low------	1.0-4.0	0.28	0.28	5	6	48
	9-27	24-32	1.45-1.55	0.60-2.00	0.15-0.19	Moderate	0.5-1.0	0.28	0.28			
	27-60	22-30	1.55-1.75	0.60-2.00	0.14-0.19	Low------	0.0-0.5	0.37	0.37			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
112:												
Harps-----------	0-19	27-35	1.35-1.40	0.60-2.00	0.19-0.21	Moderate	3.0-5.0	0.24	0.24	5	4L	86
	19-25	24-35	1.40-1.50	0.60-2.00	0.17-0.19	Moderate	1.0-3.0	0.32	0.32			
	25-60	22-30	1.55-1.75	0.60-2.00	0.14-0.19	Low------	0.0-1.0	0.32	0.32			
113:												
Webster---------	0-17	26-35	1.35-1.40	0.60-2.00	0.19-0.21	Moderate	4.0-7.0	0.24	0.24	5	6	48
	17-24	25-35	1.40-1.50	0.60-2.00	0.16-0.18	Moderate	2.0-4.0	0.32	0.32			
	24-60	22-30	1.35-1.55	0.60-2.00	0.14-0.19	Moderate	1.0-2.0	0.32	0.32			
114:												
Glencoe---------	0-10	27-35	1.35-1.45	0.20-2.00	0.18-0.22	Moderate	5.0-10	0.28	0.28	5	6	48
	10-34	25-35	1.35-1.45	0.20-2.00	0.18-0.22	Moderate	2.0-5.0	0.28	0.28			
	34-80	25-35	1.35-1.50	0.20-2.00	0.15-0.19	Moderate	1.0-4.0	0.28	0.28			
129:												
Cylinder--------	0-15	22-27	1.40-1.45	0.60-2.00	0.20-0.22	Moderate	4.0-5.0	0.24	0.24	4	6	48
	15-31	22-30	1.45-1.60	0.60-2.00	0.17-0.19	Moderate	2.0-3.0	0.32	0.32			
	31-60	2-12	1.60-1.70	20.0-63.0	0.02-0.04	Low------	0.0-0.5	0.10	0.15			
130:												
Nicollet--------	0-16	27-35	1.15-1.25	0.60-2.00	0.17-0.22	Moderate	4.0-8.0	0.24	0.24	5	6	48
	16-30	25-35	1.25-1.35	0.60-2.00	0.15-0.19	Moderate	1.0-2.0	0.32	0.32			
	30-60	22-30	1.35-1.55	0.60-2.00	0.14-0.19	Low------	0.0-1.0	0.32	0.32			
134:												
Okoboji---------	0-8	35-42	1.30-1.40	0.20-0.60	0.21-0.23	High-----	7.0-10	0.32	0.32	5	4	86
	8-28	35-45	1.30-1.40	0.20-0.60	0.18-0.20	High-----	7.0-10	0.32	0.32			
	28-60	25-35	1.35-1.40	0.20-0.60	0.18-0.20	High-----	3.0-4.0	0.32	0.32			
136:												
Madelia---------	0-16	27-35	1.20-1.30	0.60-2.00	0.18-0.24	Moderate	4.0-8.0	0.28	0.28	5	7	38
	16-30	18-35	1.25-1.35	0.60-2.00	0.16-0.22	Moderate	2.0-4.0	0.28	0.28			
	30-60	18-35	1.30-1.40	0.60-2.00	0.16-0.22	Low------	1.0-2.0	0.37	0.37			
140:												
Spicer----------	0-14	29-35	1.20-1.30	0.60-2.00	0.18-0.24	Moderate	4.0-8.0	0.28	0.28	5	4L	86
	14-27	18-35	1.25-1.35	0.60-2.00	0.16-0.22	Moderate	3.0-5.0	0.37	0.37			
	27-60	18-35	1.25-1.35	0.60-2.00	0.16-0.22	Low------	0.0-2.0	0.37	0.37			
143B:												
Chelsea---------	0-6	8-15	1.50-1.55	6.00-20.00	0.10-0.15	Low------	0.5-1.0	0.17	0.17	5	2	134
	6-60	5-10	1.55-1.70	6.00-20.00	0.06-0.08	Low------	0.0-0.5	0.17	0.17			
178:												
Granby----------	0-13	8-18	1.20-1.60	2.00-6.00	0.16-0.18	Low------	4.0-6.0	0.20	0.20	3	3	86
	13-26	0-14	1.45-1.60	6.00-20.00	0.05-0.12	Low------	0.0-0.5	0.17	0.17			
	26-60	0-10	1.45-1.60	6.00-20.00	0.05-0.09	Low------	0.0-0.5	0.17	0.17			
181:												
Litchfield------	0-20	5-10	1.30-1.50	6.00-20.00	0.10-0.12	Low------	2.0-4.0	0.17	0.17	4	2	134
	20-40	5-10	1.40-1.65	2.00-6.00	0.07-0.16	Low------	0.5-1.0	0.17	0.17			
	40-60	1-8	1.45-1.65	6.00-20.00	0.08-0.10	Low------	0.0-0.5	0.17	0.17			
183:												
Dassel----------	0-23	10-24	1.00-1.40	2.00-6.00	0.18-0.24	Low------	3.0-20	0.20	0.20	4	5	56
	23-31	2-6	1.40-1.60	2.00-6.00	0.12-0.17	Low------	1.0-4.0	0.20	0.20			
	31-60	2-8	1.45-1.65	6.00-20.00	0.08-0.10	Low------	0.0-1.0	0.20	0.20			
197:												
Kingston--------	0-16	27-32	1.20-1.30	0.60-2.00	0.18-0.24	Low------	4.0-8.0	0.28	0.28	5	7	38
	16-25	18-32	1.25-1.35	0.60-2.00	0.16-0.20	Low------	2.0-4.0	0.37	0.37			
	25-60	18-32	1.25-1.35	0.60-2.00	0.16-0.20	Low------	0.0-1.0	0.37	0.37			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
211:												
Lura------------	0-24	45-60	1.25-1.35	0.06-0.20	0.14-0.17	High-----	4.0-12	0.28	0.28	5	4	86
	24-31	45-60	1.25-1.35	0.06-0.20	0.14-0.17	High-----	1.0-4.0	0.32	0.32			
	31-60	28-60	1.30-1.45	0.06-0.60	0.11-0.19	High-----	0.0-1.0	0.32	0.32			
229:												
Waldorf---------	0-8	35-40	1.20-1.30	0.20-0.60	0.18-0.25	High-----	6.0-8.0	0.28	0.28	5	4	86
	8-35	40-55	1.25-1.35	0.06-0.60	0.13-0.16	High-----	0.5-1.0	0.32	0.32			
	35-60	24-45	1.25-1.45	0.06-0.60	0.20-0.22	Moderate	0.0-0.5	0.32	0.32			
239:												
Le Sueur--------	0-14	28-30	1.50-1.70	0.60-2.00	0.17-0.20	Moderate	3.0-7.0	0.24	0.24	5	6	48
	14-33	24-35	1.30-1.45	0.60-2.00	0.15-0.19	Moderate	0.5-2.0	0.32	0.32			
	33-60	20-30	1.45-1.60	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.32	0.32			
281:												
Darfur----------	0-23	18-25	1.20-1.35	0.60-2.00	0.20-0.22	Low------	5.0-8.0	0.20	0.20	5	5	56
	23-30	13-18	1.35-1.50	2.00-6.00	0.15-0.17	Low------	1.0-2.0	0.20	0.20			
	30-60	5-15	1.45-1.60	2.00-6.00	0.08-0.10	Low------	0.0-0.5	0.20	0.20			
286B:												
Shorewood-------	0-12	30-40	1.20-1.40	0.20-0.60	0.18-0.22	Moderate	4.0-8.0	0.28	0.28	5	7	38
	12-38	36-55	1.20-1.35	0.06-0.60	0.13-0.16	High-----	1.0-4.0	0.32	0.32			
	38-60	24-45	1.25-1.55	0.20-2.00	0.14-0.16	Moderate	0.0-1.0	0.37	0.37			
311C2:												
Shorewood-------	0-6	40-45	1.20-1.40	0.20-0.60	0.14-0.17	High-----	4.0-8.0	0.28	0.28	5	4	86
	6-20	36-55	1.20-1.35	0.06-0.60	0.13-0.16	High-----	1.0-4.0	0.32	0.32			
	20-60	24-45	1.25-1.55	0.20-2.00	0.14-0.16	Moderate	0.0-1.0	0.37	0.37			
327A:												
Dickman---------	0-12	6-18	1.30-1.40	2.00-6.00	0.13-0.15	Low------	2.0-4.0	0.20	0.20	3	3	86
	12-18	6-18	1.35-1.50	2.00-6.00	0.12-0.14	Low------	0.0-1.0	0.20	0.20			
	18-60	1-10	1.50-1.60	6.00-20.00	0.02-0.07	Low------	0.0-0.5	0.15	0.15			
327B:												
Dickman---------	0-12	6-18	1.30-1.40	2.00-6.00	0.13-0.15	Low------	2.0-4.0	0.20	0.20	3	3	86
	12-30	6-18	1.35-1.50	2.00-6.00	0.12-0.14	Low------	0.0-1.0	0.20	0.20			
	30-60	1-10	1.50-1.60	6.00-20.00	0.02-0.07	Low------	0.0-0.5	0.15	0.15			
399:												
Biscay----------	0-14	18-27	1.20-1.30	0.60-2.00	0.20-0.22	Moderate	4.0-8.0	0.28	0.28	4	6	48
	14-25	18-30	1.25-1.35	0.60-2.00	0.17-0.19	Moderate	0.5-1.0	0.28	0.28			
	25-60	1-6	1.55-1.65	6.00-63.00	0.02-0.04	Low------	0.0-0.5	0.05	0.10			
415:												
Kanaranzi-------	0-9	18-27	1.30-1.45	0.60-2.00	0.17-0.21	Low------	2.0-5.0	0.24	0.24	4	6	48
	9-18	18-32	1.35-1.50	0.60-2.00	0.15-0.19	Low------	0.0-0.5	0.37	0.37			
	18-60	0-5	1.55-1.65	6.00-40.00	0.02-0.04	Low------	---	0.10	0.15			
423:												
Seaforth--------	0-12	20-30	1.30-1.45	0.60-2.00	0.17-0.24	Moderate	3.0-6.0	0.24	0.24	5	4L	86
	12-28	20-30	1.30-1.50	0.60-2.00	0.15-0.19	Moderate	0.0-2.0	0.28	0.28			
	28-60	20-27	1.35-1.60	0.60-2.00	0.17-0.19	Low------	0.0-1.0	0.28	0.28			
461B:												
Koronis---------	0-8	10-20	1.20-1.40	2.00-6.00	0.20-0.22	Low------	1.0-4.0	0.28	0.28	5	5	56
	8-31	18-24	1.30-1.50	0.60-6.00	0.15-0.19	Low------	0.0-2.0	0.28	0.28			
	31-60	12-20	1.35-1.60	2.00-6.00	0.11-0.16	Low------	0.0-1.0	0.28	0.28			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
461C2:												
Koronis---------	0-8	10-20	1.20-1.40	2.00-6.00	0.20-0.22	Low------	1.0-4.0	0.28	0.28	5	5	56
	8-24	18-24	1.30-1.50	0.60-6.00	0.15-0.19	Low------	0.0-2.0	0.28	0.28			
	24-60	12-20	1.35-1.60	2.00-6.00	0.11-0.16	Low------	0.0-1.0	0.28	0.28			
511:												
Marcellon-------	0-13	13-20	1.25-1.35	0.60-2.00	0.17-0.24	Low------	3.0-7.0	0.24	0.24	5	5	56
	13-32	20-24	1.45-1.55	0.60-2.00	0.12-0.18	Moderate	0.0-1.0	0.32	0.32			
	32-60	8-17	1.55-1.65	2.00-6.00	0.07-0.14	Low------	0.0-0.5	0.24	0.24			
523:												
Houghton--------	0-7	---	0.20-0.35	0.20-6.00	0.35-0.45	---------	70-99	---	---	3	2	134
	7-60	---	0.15-0.25	0.20-6.00	0.35-0.45	---------	70-99	---	---			
525:												
Muskego---------	0-10	---	0.10-0.21	0.60-6.00	0.35-0.45	---------	60-90	0.10	0.10	1	2	134
	10-40	---	0.10-0.21	0.60-6.00	0.35-0.45	---------	60-90	0.10	0.10			
	40-60	18-35	0.30-1.10	0.06-0.20	0.18-0.24	Moderate	6.0-20	0.28	0.28			
539:												
Klossner--------	0-28	---	0.25-0.55	0.20-6.00	0.35-0.48	---------	25-60	---	---	2	2	134
	28-45	22-35	1.10-1.25	0.60-2.00	0.22-0.26	Moderate	10-20	0.37	0.37			
	45-60	15-32	1.35-1.50	0.60-2.00	0.15-0.19	Moderate	0.0-5.0	0.28	0.28			
548:												
Medo------------	0-24	---	0.25-0.45	0.20-6.00	0.35-0.45	---------	20-50	---	---	2	2	134
	24-29	15-30	1.15-1.65	0.60-6.00	0.13-0.20	Moderate	5.0-20	0.24	0.24			
	29-56	15-30	1.35-1.65	0.60-6.00	0.13-0.20	Moderate	1.0-4.0	0.32	0.32			
	56-60	0-10	1.50-1.65	2.00-20.00	0.03-0.10	Low------	0.5-2.0	0.10	0.10			
610:												
Calco-----------	0-6	28-33	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	5.0-7.0	0.28	0.28	5	4L	86
	6-55	30-35	1.25-1.30	0.60-2.00	0.21-0.23	Moderate	3.0-5.0	0.28	0.28			
	55-60	22-32	1.30-1.45	0.60-2.00	0.18-0.20	Moderate	1.0-3.0	0.32	0.32			
611D:												
Hawick----------	0-7	2-10	1.50-1.65	2.00-20.00	0.03-0.13	Low------	1.0-3.0	0.10	0.15	5	8	---
	7-10	1-10	1.50-1.65	6.00-20.00	0.03-0.10	Low------	0.0-0.5	0.10	0.15			
	10-60	1-5	1.55-1.65	20.00-40.00	0.02-0.06	Low------	0.0-0.5	0.10	0.15			
612B:												
Wadenill--------	0-13	12-22	1.30-1.50	0.60-2.00	0.20-0.22	Low------	2.0-5.0	0.24	0.24	5	5	56
	13-30	8-18	1.30-1.55	2.00-6.00	0.12-0.19	Low------	1.0-2.0	0.24	0.24			
	30-60	8-18	1.40-1.60	2.00-6.00	0.11-0.19	Low------	0.0-1.0	0.28	0.28			
613:												
Grovecity-------	0-15	12-22	1.30-1.50	2.00-6.00	0.20-0.22	Low------	4.0-8.0	0.20	0.20	5	5	56
	15-30	10-18	1.30-1.55	2.00-6.00	0.12-0.19	Low------	0.0-1.0	0.20	0.20			
	30-60	8-18	1.40-1.60	2.00-6.00	0.11-0.19	Low------	0.0-0.5	0.20	0.20			
664:												
Zook------------	0-10	35-40	1.30-1.35	0.20-0.60	0.21-0.23	High-----	5.0-7.0	0.37	0.37	5	7	38
	10-41	36-45	1.30-1.45	0.06-0.20	0.11-0.13	High-----	2.0-4.0	0.28	0.28			
	41-60	20-45	1.30-1.45	0.06-0.60	0.11-0.22	High-----	0.0-1.0	0.28	0.28			
740:												
Hamel-----------	0-28	20-27	1.30-1.40	0.60-2.00	0.20-0.24	Low------	5.0-7.0	0.28	0.28	5	6	48
	28-56	24-35	1.45-1.60	0.20-0.60	0.16-0.19	Moderate	2.0-5.0	0.28	0.28			
	56-60	20-30	1.55-1.75	0.60-2.00	0.14-0.18	Moderate	0.0-3.0	0.28	0.28			
Glencoe---------	0-15	25-27	1.35-1.45	0.60-2.00	0.18-0.22	Moderate	5.0-10	0.28	0.28	5	6	48
	15-45	25-35	1.35-1.45	0.20-2.00	0.18-0.22	Moderate	2.0-5.0	0.28	0.28			
	45-60	25-35	1.35-1.50	0.20-2.00	0.15-0.19	Moderate	1.0-4.0	0.28	0.28			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
804B:												
Koronis----------	0-8	10-20	1.20-1.40	2.00-6.00	0.20-0.22	Low------	1.0-4.0	0.28	0.28	5	5	56
	8-33	18-24	1.30-1.50	0.60-6.00	0.15-0.19	Low------	0.0-2.0	0.28	0.28			
	33-60	12-20	1.35-1.60	2.00-6.00	0.11-0.16	Low------	0.0-1.0	0.28	0.28			
Sunburg----------	0-9	12-20	1.35-1.55	2.00-6.00	0.16-0.18	Low------	1.0-4.0	0.24	0.24	5	3	86
	9-60	10-18	1.40-1.60	2.00-6.00	0.11-0.19	Low------	0.0-1.0	0.24	0.24			
Hawick-----------	0-9	2-10	1.50-1.65	2.00-20.00	0.03-0.13	Low------	1.0-3.0	0.10	0.15	5	8	---
	9-49	1-10	1.50-1.65	6.00-20.00	0.03-0.10	Low------	0.0-0.5	0.10	0.15			
	49-60	1-5	1.55-1.65	20.00-40.00	0.02-0.06	Low------	0.0-0.5	0.10	0.15			
804C2:												
Koronis----------	0-8	6-16	1.25-1.45	2.00-6.00	0.13-0.18	Low------	1.0-4.0	0.24	0.24	5	3	86
	8-26	18-24	1.30-1.50	0.60-6.00	0.15-0.19	Low------	0.0-2.0	0.28	0.28			
	26-60	12-20	1.35-1.60	2.00-6.00	0.11-0.16	Low------	0.0-1.0	0.28	0.28			
Sunburg----------	0-10	12-20	1.35-1.55	2.00-6.00	0.16-0.18	Low------	1.0-4.0	0.24	0.24	5	3	86
	10-60	10-18	1.40-1.60	2.00-6.00	0.11-0.19	Low------	0.0-1.0	0.24	0.24			
Hawick-----------	0-9	2-10	1.50-1.65	2.00-20.00	0.03-0.13	Low------	1.0-3.0	0.10	0.15	5	8	---
	9-60	1-10	1.50-1.65	6.00-20.00	0.03-0.10	Low------	0.0-0.5	0.10	0.15			
804D2:												
Koronis----------	0-8	6-16	1.25-1.45	2.00-6.00	0.13-0.18	Low------	1.0-4.0	0.24	0.24	5	3	86
	8-25	18-24	1.30-1.50	0.60-6.00	0.15-0.19	Low------	0.0-2.0	0.28	0.28			
	25-60	12-20	1.35-1.60	2.00-6.00	0.11-0.16	Low------	0.0-1.0	0.28	0.28			
Sunburg----------	0-7	12-20	1.35-1.55	2.00-6.00	0.16-0.18	Low------	1.0-4.0	0.24	0.24	5	3	86
	7-60	10-18	1.40-1.60	2.00-6.00	0.11-0.19	Low------	0.0-1.0	0.24	0.24			
Hawick-----------	0-7	2-10	1.50-1.65	2.00-20.00	0.03-0.13	Low------	1.0-3.0	0.10	0.15	5	8	---
	7-20	1-10	1.50-1.65	6.00-20.00	0.03-0.10	Low------	0.0-0.5	0.10	0.15			
	20-60	1-5	1.55-1.65	20.00-40.00	0.02-0.06	Low------	0.0-0.5	0.10	0.15			
804E:												
Koronis----------	0-5	6-16	1.25-1.45	2.00-6.00	0.13-0.18	Low------	1.0-4.0	0.24	0.24	5	3	86
	5-21	18-24	1.30-1.50	0.60-6.00	0.15-0.19	Low------	0.0-2.0	0.28	0.28			
	21-60	12-20	1.35-1.60	2.00-6.00	0.11-0.16	Low------	0.0-1.0	0.28	0.28			
Sunburg----------	0-4	12-20	1.35-1.55	2.00-6.00	0.16-0.18	Low------	1.0-4.0	0.24	0.24	5	3	86
	4-60	10-18	1.40-1.60	2.00-6.00	0.11-0.19	Low------	0.0-1.0	0.24	0.24			
Hawick-----------	0-14	2-10	1.50-1.65	2.00-20.00	0.03-0.13	Low------	1.0-3.0	0.10	0.15	5	8	---
	14-60	1-10	1.50-1.65	6.00-20.00	0.03-0.10	Low------	0.0-0.5	0.10	0.15			
805C2:												
Sunburg----------	0-8	12-20	1.35-1.55	2.00-6.00	0.16-0.18	Low------	1.0-4.0	0.24	0.24	5	3	86
	8-60	10-18	1.40-1.60	2.00-6.00	0.11-0.19	Low------	0.0-1.0	0.24	0.24			
Wadenill---------	0-7	12-22	1.30-1.50	0.60-2.00	0.20-0.22	Low------	2.0-5.0	0.24	0.24	5	5	56
	7-20	8-18	1.30-1.55	2.00-6.00	0.12-0.19	Low------	1.0-2.0	0.24	0.24			
	20-60	8-18	1.40-1.60	2.00-6.00	0.11-0.19	Low------	0.0-1.0	0.28	0.28			
805D2:												
Sunburg----------	0-7	12-20	1.35-1.55	2.00-6.00	0.16-0.18	Low------	1.0-4.0	0.24	0.24	5	3	86
	7-60	10-18	1.40-1.60	2.00-6.00	0.11-0.19	Low------	0.0-1.0	0.24	0.24			
Wadenill---------	0-7	12-22	1.30-1.50	0.60-2.00	0.20-0.22	Low------	2.0-5.0	0.24	0.24	5	5	56
	7-18	8-18	1.30-1.55	2.00-6.00	0.12-0.19	Low------	1.0-2.0	0.24	0.24			
	18-60	8-18	1.40-1.60	2.00-6.00	0.11-0.19	Low------	0.0-1.0	0.28	0.28			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
807D2:												
Koronis----------	0-9	6-16	1.25-1.45	2.00-6.00	0.13-0.18	Low------	1.0-4.0	0.24	0.24	5	3	86
	9-25	18-24	1.30-1.50	0.60-6.00	0.15-0.19	Low------	0.0-2.0	0.28	0.28			
	25-60	12-20	1.35-1.60	2.00-6.00	0.11-0.16	Low------	0.0-1.0	0.28	0.28			
Sunburg----------	0-7	12-20	1.35-1.55	2.00-6.00	0.16-0.18	Low------	1.0-4.0	0.24	0.24	5	3	86
	7-60	10-18	1.40-1.60	2.00-6.00	0.11-0.19	Low------	0.0-1.0	0.24	0.24			
875B:												
Estherville------	0-9	5-15	1.25-1.35	2.00-6.00	0.13-0.18	Low------	2.0-4.0	0.20	0.20	3	3	86
	9-14	10-18	1.35-1.60	2.00-6.00	0.13-0.18	Low------	0.0-0.5	0.20	0.20			
	14-60	0-8	1.50-1.65	6.00-63.00	0.02-0.04	Low------	0.0-0.5	0.10	0.10			
Hawick-----------	0-7	5-15	1.35-1.55	2.00-6.00	0.13-0.15	Low------	1.0-4.0	0.17	0.17	3	3	86
	7-11	1-10	1.50-1.65	6.00-20.00	0.03-0.10	Low------	0.0-0.5	0.10	0.15			
	11-60	1-5	1.55-1.65	20.00-40.00	0.02-0.06	Low------	0.0-0.5	0.10	0.15			
875C:												
Hawick-----------	0-11	2-10	1.50-1.65	2.00-20.00	0.03-0.13	Low------	1.0-3.0	0.10	0.15	5	8	---
	11-60	1-5	1.55-1.65	20.00-40.00	0.02-0.06	Low------	0.0-0.5	0.10	0.15			
Estherville------	0-8	5-15	1.25-1.35	2.00-6.00	0.13-0.18	Low------	2.0-4.0	0.20	0.20	3	3	86
	8-13	10-18	1.35-1.60	2.00-6.00	0.13-0.18	Low------	0.0-0.5	0.20	0.20			
	13-60	0-8	1.50-1.65	6.00-63.00	0.02-0.04	Low------	0.0-0.5	0.10	0.10			
887B:												
Clarion----------	0-11	20-27	1.30-1.55	0.60-2.00	0.20-0.22	Low------	3.0-6.0	0.24	0.24	5	6	48
	11-30	23-30	1.30-1.55	0.60-2.00	0.17-0.19	Moderate	0.5-1.0	0.37	0.37			
	30-60	22-30	1.30-1.55	0.60-2.00	0.17-0.19	Moderate	0.0-0.5	0.37	0.37			
Swanlake---------	0-8	18-27	1.35-1.45	0.60-2.00	0.20-0.24	Low------	2.0-4.0	0.28	0.28	5	4L	86
	8-12	18-30	1.30-1.50	0.60-2.00	0.17-0.19	Moderate	0.0-2.0	0.37	0.37			
	12-60	18-30	1.30-1.50	0.60-2.00	0.17-0.19	Moderate	0.0-1.0	0.37	0.37			
899:												
Harps------------	0-9	27-35	1.35-1.40	0.60-2.00	0.19-0.21	Moderate	3.0-5.0	0.24	0.24	5	4L	86
	9-28	24-35	1.40-1.50	0.60-2.00	0.17-0.19	Moderate	1.0-3.0	0.32	0.32			
	28-60	22-30	1.55-1.75	0.60-2.00	0.14-0.19	Low------	0.0-1.0	0.32	0.32			
Okoboji----------	0-17	35-42	1.30-1.40	0.20-0.60	0.21-0.23	High-----	7.0-10	0.32	0.32	5	4	86
	17-47	35-45	1.30-1.40	0.20-0.60	0.18-0.20	High-----	7.0-10	0.32	0.32			
	47-60	25-35	1.35-1.40	0.20-0.60	0.18-0.20	High-----	3.0-4.0	0.32	0.32			
909C2:												
Bold-------------	0-7	12-18	1.40-1.60	0.60-2.00	0.21-0.24	Low------	0.5-2.0	0.43	0.43	5	4L	86
	7-60	12-18	1.10-1.30	0.60-2.00	0.20-0.24	Low------	0.0-0.5	0.43	0.43			
Truman-----------	0-10	18-27	1.25-1.35	0.60-2.00	0.20-0.23	Low------	4.0-8.0	0.32	0.32	5	6	48
	10-31	18-32	1.30-1.45	0.60-2.00	0.18-0.21	Low------	1.0-2.0	0.43	0.43			
	31-60	18-32	1.35-1.45	0.60-2.00	0.18-0.20	Low------	0.0-1.0	0.43	0.43			
909D2:												
Bold-------------	0-7	12-18	1.40-1.60	0.60-2.00	0.21-0.24	Low------	0.5-2.0	0.43	0.43	5	4L	86
	7-60	12-18	1.10-1.30	0.60-2.00	0.20-0.24	Low------	0.0-0.5	0.43	0.43			
Truman-----------	0-13	18-27	1.25-1.35	0.60-2.00	0.20-0.23	Low------	4.0-8.0	0.32	0.32	5	6	48
	13-22	18-32	1.30-1.45	0.60-2.00	0.18-0.21	Low------	1.0-2.0	0.43	0.43			
	22-60	18-32	1.35-1.45	0.60-2.00	0.18-0.20	Low------	0.0-1.0	0.43	0.43			
920B:												
Clarion----------	0-12	20-27	1.30-1.55	0.60-2.00	0.20-0.22	Low------	3.0-6.0	0.24	0.24	5	6	48
	12-23	23-30	1.30-1.55	0.60-2.00	0.17-0.19	Moderate	0.5-1.0	0.37	0.37			
	23-60	22-30	1.30-1.55	0.60-2.00	0.17-0.19	Moderate	0.0-0.5	0.37	0.37			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors K	Erosion factors Kf	Erosion factors T	Wind erodibility group	Wind erodibility index
	In	Pct	g/cc	In/hr	In/in		Pct					
920B:												
Storden---------	0-7	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low------	1.0-2.0	0.28	0.28	5	4L	86
	7-37	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	37-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
Hawick----------	0-9	2-10	1.50-1.65	2.00-20.00	0.03-0.13	Low------	1.0-3.0	0.10	0.15	5	8	---
	9-28	1-10	1.50-1.65	6.00-20.00	0.03-0.10	Low------	0.0-0.5	0.10	0.15			
	28-60	1-5	1.55-1.65	20.00-40.00	0.02-0.06	Low------	0.0-0.5	0.10	0.15			
945D2:												
Lester----------	0-9	20-27	1.30-1.40	0.60-2.00	0.20-0.22	Low------	1.0-4.0	0.28	0.28	5	6	48
	9-26	24-32	1.45-1.55	0.60-2.00	0.15-0.19	Moderate	0.5-1.0	0.28	0.28			
	26-60	22-30	1.55-1.75	0.60-2.00	0.14-0.19	Low------	0.0-0.5	0.37	0.37			
Storden---------	0-5	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low------	1.0-2.0	0.28	0.28	5	4L	86
	5-28	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	28-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
945E:												
Lester----------	0-7	20-27	1.30-1.40	0.60-2.00	0.20-0.22	Low------	1.0-4.0	0.28	0.28	5	6	48
	7-23	24-32	1.45-1.55	0.60-2.00	0.15-0.19	Moderate	0.5-1.0	0.28	0.28			
	23-60	22-30	1.55-1.75	0.60-2.00	0.14-0.19	Low------	0.0-0.5	0.37	0.37			
Storden---------	0-9	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low------	1.0-2.0	0.28	0.28	5	4L	86
	9-30	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	30-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
956:												
Canisteo--------	0-17	27-35	1.25-1.35	0.60-2.00	0.18-0.22	Moderate	4.0-8.0	0.24	0.24	5	4L	86
	17-23	25-35	1.35-1.50	0.60-2.00	0.15-0.19	Moderate	2.0-4.0	0.32	0.32			
	23-41	25-35	1.30-1.50	0.60-2.00	0.12-0.18	Low------	0.5-1.0	0.32	0.32			
	41-60	22-30	1.45-1.60	0.60-2.00	0.14-0.16	Low------	0.0-0.5	0.32	0.32			
Glencoe---------	0-7	27-35	1.35-1.45	0.20-2.00	0.18-0.22	Moderate	5.0-10	0.28	0.28	5	6	48
	7-36	25-35	1.35-1.45	0.20-2.00	0.18-0.22	Moderate	2.0-5.0	0.28	0.28			
	36-60	25-35	1.35-1.50	0.20-2.00	0.15-0.19	Moderate	1.0-4.0	0.28	0.28			
960C2:												
Storden---------	0-8	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low------	1.0-2.0	0.28	0.28	5	4L	86
	8-21	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	21-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
Omsrud----------	0-9	20-26	1.35-1.45	0.60-2.00	0.20-0.22	Low------	2.0-4.0	0.24	0.24	5	6	48
	9-25	22-30	1.35-1.50	0.60-2.00	0.17-0.19	Low------	0.5-2.0	0.32	0.32			
	25-60	22-30	1.35-1.60	0.60-2.00	0.17-0.19	Low------	0.0-1.0	0.37	0.37			
960D2:												
Storden---------	0-7	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low------	1.0-2.0	0.28	0.28	5	4L	86
	7-23	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	23-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
Omsrud----------	0-8	20-26	1.35-1.45	0.60-2.00	0.20-0.22	Low------	2.0-4.0	0.24	0.24	5	6	48
	8-22	22-30	1.35-1.50	0.60-2.00	0.17-0.19	Low------	0.5-2.0	0.32	0.32			
	22-60	22-30	1.35-1.60	0.60-2.00	0.17-0.19	Low------	0.0-1.0	0.37	0.37			
978:												
Cordova---------	0-15	27-30	1.25-1.45	0.20-0.60	0.18-0.22	Moderate	4.0-7.0	0.28	0.28	5	6	48
	15-39	28-35	1.35-1.50	0.20-0.60	0.15-0.19	Moderate	1.0-4.0	0.28	0.28			
	39-60	18-30	1.45-1.70	0.60-2.00	0.14-0.16	Moderate	0.0-1.0	0.28	0.28			
Rolfe-----------	0-28	22-27	1.35-1.40	0.60-2.00	0.22-0.24	Low------	3.0-5.0	0.37	0.37	5	6	48
	28-40	38-45	1.40-1.50	0.06-0.20	0.11-0.13	High-----	1.0-2.0	0.28	0.28			
	40-60	24-35	1.50-1.60	0.20-2.00	0.14-0.16	Moderate	0.0-1.0	0.28	0.28			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
1015:												
Udipsamments----	0-14	1-15	1.50-1.70	2.00-20.00	0.05-0.10	Low------	0.0-0.5	0.15	0.15	5	2	220
	14-60	1-10	1.50-1.70	6.00-20.00	0.05-0.08	Low------	---	0.10	0.10			
	60-80	1-10	1.50-1.70	>20.00	0.03-0.05	Low------	---	0.05	0.10			
1016:												
Udorthents------	0-60	2-18	1.50-1.70	0.60-6.00	0.08-0.14	Low------	0.5-1.0	0.24	0.28	5	3	86
	60-80	---	---	0.06-6.00	---	---------	---	---	---			
1030:												
Pits, gravel.												
Udipsamments----	0-14	1-15	1.50-1.70	2.00-20.00	0.05-0.10	Low------	0.0-0.5	0.15	0.15	5	2	220
	14-60	1-10	1.50-1.70	6.00-20.00	0.05-0.08	Low------	---	0.10	0.10			
	60-80	1-10	1.50-1.70	>20.00	0.03-0.05	Low------	---	0.05	0.10			
1080:												
Klossner--------	0-25	---	0.25-0.45	0.20-6.00	0.35-0.45	---------	25-60	---	---	2	8	---
	25-60	20-35	1.45-1.70	0.20-2.00	0.14-0.22	Moderate	5.0-20	0.28	0.28			
Okoboji---------	0-10	30-40	1.20-1.25	0.60-2.00	0.22-0.25	Moderate	10-18	0.32	0.32	5	6	48
	10-42	35-45	1.35-1.40	0.20-0.60	0.18-0.20	High-----	---	0.37	0.37			
	42-60	35-45	1.35-1.40	0.20-0.60	0.18-0.20	High-----	---	0.37	0.37			
Glencoe---------	0-42	27-35	1.35-1.45	0.20-2.00	0.18-0.22	Moderate	5.0-10	0.28	0.28	5	8	---
	42-50	25-35	1.35-1.50	0.20-2.00	0.15-0.19	Moderate	2.0-6.0	0.28	0.28			
	50-60	22-32	1.35-1.50	0.60-2.00	0.15-0.19	Low------	0.0-3.0	0.28	0.28			
1096:												
Fieldon---------	0-20	15-22	1.25-1.40	0.60-6.00	0.18-0.20	Low------	5.0-8.0	0.28	0.28	4	4L	86
	20-26	10-18	1.35-1.55	0.60-6.00	0.15-0.17	Low------	2.0-6.0	0.20	0.20			
	26-60	5-15	1.40-1.60	6.00-20.00	0.05-0.07	Low------	0.0-0.5	0.20	0.20			
Dassel----------	0-21	10-24	1.00-1.40	2.00-6.00	0.18-0.24	Low------	3.0-20	0.20	0.20	4	5	56
	21-32	2-6	1.40-1.60	2.00-6.00	0.12-0.17	Low------	1.0-4.0	0.20	0.20			
	32-60	2-8	1.45-1.65	6.00-20.00	0.08-0.10	Low------	0.0-1.0	0.20	0.20			
1097:												
Mayer-----------	0-16	18-30	1.25-1.35	0.60-2.00	0.20-0.22	Low------	4.0-8.0	0.24	0.24	4	4L	86
	16-25	18-30	1.25-1.35	0.60-2.00	0.16-0.19	Low------	2.0-6.0	0.28	0.28			
	25-60	1-5	1.55-1.65	6.00-20.00	0.02-0.04	Low------	1.0-4.0	0.15	0.15			
Biscay----------	0-20	27-30	1.20-1.30	0.60-2.00	0.20-0.22	Moderate	4.0-8.0	0.28	0.28	4	6	48
	20-25	18-30	1.25-1.35	0.60-2.00	0.17-0.19	Moderate	0.5-1.0	0.28	0.28			
	25-28	10-28	1.35-1.55	2.00-6.00	0.11-0.17	Low------	0.0-0.5	0.28	0.32			
	28-60	1-6	1.55-1.65	6.00-63.00	0.02-0.04	Low------	0.0-0.5	0.05	0.10			
1098:												
Biscay----------	0-20	18-30	1.20-1.30	0.60-2.00	0.20-0.22	Moderate	4.0-8.0	0.28	0.28	4	6	48
	20-25	18-30	1.25-1.35	0.60-2.00	0.17-0.19	Moderate	0.5-1.0	0.28	0.28			
	25-60	1-6	1.55-1.65	6.00-63.00	0.02-0.04	Low------	0.0-0.5	0.05	0.10			
Biscay, depressional---	0-18	27-30	1.20-1.30	0.60-2.00	0.20-0.22	Moderate	4.0-8.0	0.28	0.28	4	6	48
	18-22	18-30	1.25-1.35	0.60-2.00	0.17-0.19	Moderate	0.5-1.0	0.28	0.28			
	22-26	10-28	1.35-1.55	2.00-6.00	0.11-0.17	Low------	0.0-0.5	0.28	0.32			
	26-60	1-6	1.55-1.65	6.00-63.00	0.02-0.04	Low------	0.0-0.5	0.05	0.10			
1099:												
Granby----------	0-12	2-14	1.20-1.60	6.00-20.00	0.10-0.12	Low------	4.0-10	0.17	0.17	5	2	134
	12-24	0-14	1.45-1.60	6.00-20.00	0.05-0.12	Low------	---	0.17	0.17			
	24-60	0-10	1.45-1.60	6.00-20.00	0.05-0.09	Low------	---	0.17	0.17			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors K	Erosion factors Kf	Erosion factors T	Wind erodi- bility group	Wind erodi- bility index
	In	Pct	g/cc	In/hr	In/in		Pct					
1100:												
Nicollet	0-13	27-35	1.15-1.25	0.60-2.00	0.17-0.22	Moderate	4.0-8.0	0.24	0.24	5	7	38
	13-26	25-35	1.25-1.35	0.60-2.00	0.15-0.19	Moderate	1.0-2.0	0.32	0.32			
	26-60	22-30	1.35-1.55	0.60-2.00	0.14-0.19	Low	0.0-1.0	0.32	0.32			
1101:												
Webster	0-19	27-35	1.35-1.40	0.60-2.00	0.19-0.21	Moderate	4.0-7.0	0.28	0.28	5	7	38
	19-24	25-35	1.40-1.50	0.60-2.00	0.16-0.18	Moderate	2.0-4.0	0.32	0.32			
	24-60	22-30	1.35-1.55	0.60-2.00	0.14-0.19	Moderate	1.0-2.0	0.32	0.32			
1159B:												
Strout	0-10	35-45	1.30-1.50	0.20-0.60	0.14-0.19	High	3.0-6.0	0.28	0.28	5	4	86
	10-24	35-50	1.40-1.70	0.20-0.60	0.12-0.18	High	0.5-2.0	0.24	0.24			
	24-60	30-45	1.60-1.80	0.06-0.60	0.10-0.15	High	0.0-1.0	0.37	0.37			
Arkton	0-9	30-40	1.30-1.60	0.20-0.60	0.15-0.19	Moderate	2.0-5.0	0.24	0.24	5	6	48
	9-25	30-45	1.40-1.70	0.20-0.60	0.10-0.19	High	0.0-2.0	0.28	0.28			
	25-60	25-40	1.60-1.80	0.06-0.60	0.13-0.19	Moderate	0.0-1.0	0.37	0.37			
1161:												
Barry	0-11	16-23	1.55-1.70	2.00-6.00	0.17-0.19	Low	4.0-6.0	0.24	0.24	5	6	48
	11-33	18-25	1.60-1.80	0.60-2.00	0.15-0.18	Moderate	0.5-1.0	0.28	0.32			
	33-60	10-16	1.55-1.70	2.00-6.00	0.11-0.14	Low	0.0-0.5	0.24	0.28			
1162A:												
Kandiyohi	0-11	40-50	1.30-1.50	0.06-0.60	0.16-0.22	High	4.0-7.0	0.28	0.28	5	4	86
	11-26	35-60	1.40-1.60	0.06-0.60	0.14-0.19	High	0.5-2.0	0.32	0.32			
	26-33	30-55	1.50-1.70	0.06-0.20	0.13-0.19	High	0.0-1.0	0.37	0.37			
	33-60	30-55	1.60-1.80	0.06-0.20	0.11-0.15	High	0.0-1.0	0.37	0.37			
1162B:												
Kandiyohi	0-10	40-50	1.30-1.50	0.06-0.60	0.16-0.22	High	4.0-7.0	0.28	0.28	5	4	86
	10-23	35-60	1.40-1.60	0.06-0.60	0.14-0.19	High	0.5-2.0	0.32	0.32			
	23-29	30-55	1.50-1.70	0.06-0.20	0.13-0.19	High	0.0-1.0	0.37	0.37			
	29-60	30-55	1.60-1.80	0.06-0.20	0.11-0.15	High	0.0-1.0	0.37	0.37			
1163:												
Cohoctah	0-17	7-20	1.20-1.60	2.00-6.00	0.18-0.24	Low	3.0-6.0	.28	.28	4	5	56
	17-22	5-18	1.45-1.65	2.00-6.00	0.12-0.20	Low	0.5-1.0	.28	.28			
	22-60	2-5	1.55-1.65	6.00-63.00	0.06-0.09	Low	0.0-0.5	.10	.10			
Lundlake	0-14	28-35	1.20-1.45	0.20-2.00	0.17-0.22	Moderate	5.0-12	0.28	0.28	5	7	38
	14-35	20-30	1.20-1.45	0.20-2.00	0.17-0.22	Moderate	2.0-5.0	0.28	0.28			
	35-47	18-27	1.30-1.50	0.60-2.00	0.15-0.19	Low	1.0-2.0	0.28	0.28			
	47-60	10-18	1.40-1.60	2.00-6.00	0.10-0.15	Low	0.0-1.0	0.28	0.28			
1168:												
Swedegrove	0-15	14-24	1.20-1.40	2.00-6.00	0.16-0.20	Low	5.0-7.0	0.24	0.24	5	4L	86
	15-31	16-22	1.30-1.50	2.00-6.00	0.14-0.18	Low	1.0-3.0	0.28	0.28			
	31-60	10-16	1.40-1.60	2.00-6.00	0.10-0.15	Low	0.0-1.0	0.28	0.28			
Lundlake	0-12	28-35	1.20-1.45	0.20-2.00	0.17-0.22	Moderate	5.0-12	0.28	0.28	5	7	38
	12-28	20-30	1.20-1.45	0.20-2.00	0.17-0.22	Moderate	2.0-5.0	0.28	0.28			
	28-36	18-27	1.30-1.50	0.60-2.00	0.15-0.19	Low	1.0-2.0	0.28	0.28			
	36-60	10-18	1.40-1.60	2.00-6.00	0.10-0.15	Low	0.0-1.0	0.28	0.28			
1169:												
Corvuso	0-11	35-55	1.30-1.45	0.06-0.60	0.14-0.22	High	4.0-7.0	0.24	0.24	5	4L	86
	11-28	35-60	1.40-1.60	0.06-0.60	0.13-0.19	High	0.0-1.0	0.32	0.32			
	28-60	30-55	1.60-1.80	0.06-0.20	0.11-0.15	High	0.0-0.5	0.37	0.37			
Lura	0-26	45-60	1.25-1.35	0.06-0.20	0.14-0.17	High	4.0-12	0.28	0.28	5	4	86
	26-60	45-60	1.25-1.35	0.06-0.20	0.14-0.17	High	1.0-4.0	0.32	0.32			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors K	Erosion factors Kf	Erosion factors T	Wind erodibility group	Wind erodibility index
	In	Pct	g/cc	In/hr	In/in		Pct					
1171C:												
Newlondon-------	0-7	30-45	1.30-1.60	0.20-0.60	0.16-0.18	High-----	1.0-2.0	0.28	0.28	5	4	86
	7-38	35-45	1.40-1.60	0.20-0.60	0.14-0.18	High-----	0.0-1.0	0.28	0.28			
	38-60	25-40	1.60-1.80	0.06-0.60	0.13-0.19	Moderate	0.0-0.5	0.37	0.37			
Strout----------	0-9	35-45	1.30-1.50	0.20-0.60	0.14-0.19	High-----	3.0-6.0	0.28	0.28	5	4	86
	9-23	35-50	1.40-1.70	0.20-0.60	0.12-0.18	High-----	0.5-2.0	0.24	0.24			
	23-60	30-45	1.60-1.80	0.06-0.60	0.10-0.15	High-----	0.0-1.0	0.37	0.37			
1171D:												
Newlondon-------	0-7	30-45	1.30-1.60	0.20-0.60	0.16-0.18	High-----	1.0-2.0	0.28	0.28	5	4	86
	7-38	35-45	1.40-1.60	0.20-0.60	0.14-0.18	High-----	0.0-1.0	0.28	0.28			
	38-60	25-40	1.60-1.80	0.06-0.60	0.13-0.19	Moderate	0.0-0.5	0.37	0.37			
Strout----------	0-9	35-45	1.30-1.50	0.20-0.60	0.14-0.19	High-----	3.0-6.0	0.28	0.28	5	4	86
	9-19	35-50	1.40-1.70	0.20-0.60	0.12-0.18	High-----	0.5-2.0	0.24	0.24			
	19-60	30-45	1.60-1.80	0.06-0.60	0.10-0.15	High-----	0.0-1.0	0.37	0.37			
1172C:												
Sparta----------	0-18	3-10	1.20-1.40	2.00-6.00	0.09-0.12	Low------	1.0-2.0	0.17	0.17	5	2	134
	18-55	1-8	1.40-1.60	6.00-20.00	0.05-0.11	Low------	0.1-1.0	0.15	0.15			
	55-60	0-5	1.50-1.70	6.00-20.00	0.04-0.07	Low------	0.0-0.5	0.15	0.15			
Gardencity------	0-7	5-20	1.30-1.40	2.00-6.00	0.16-0.20	Low------	2.0-4.0	0.20	0.20	5	3	86
	7-24	12-18	1.40-1.50	2.00-6.00	0.11-0.17	Low------	0.5-2.0	0.20	0.20			
	24-60	10-20	1.40-1.50	2.00-6.00	0.10-0.17	Low------	0.0-0.5	0.20	0.20			
1173:												
Muskego---------	0-45	---	0.10-0.21	0.60-6.00	0.35-0.45	Low------	60-90	0.10	0.10	1	2	134
	45-60	18-35	0.30-1.10	0.06-0.20	0.20-0.25	Moderate	6.0-20	0.28	0.28			
Klossner--------	0-22	---	0.25-0.55	0.20-6.00	0.35-0.48	---------	25-60	---	---	2	2	134
	22-45	22-35	1.10-1.25	0.60-2.00	0.22-0.26	Moderate	10-20	0.37	0.37			
	45-60	15-32	1.30-1.40	0.20-2.00	0.18-0.22	Moderate	5.0-10	0.28	0.28			
1174:												
Danielson-------	0-9	35-40	1.20-1.40	0.06-0.60	0.15-0.22	High-----	5.0-10	0.28	0.28	5	4	86
	9-36	35-45	1.40-1.60	0.06-0.60	0.14-0.19	High-----	4.0-10	0.28	0.28			
	36-51	35-55	1.40-1.80	0.06-0.60	0.07-0.19	High-----	0.0-1.0	0.28	0.28			
	51-60	30-55	1.60-1.80	0.06-0.20	0.07-0.18	High-----	0.0-0.5	0.28	0.28			
1175:												
Swedegrove------	0-14	14-24	1.20-1.40	2.00-6.00	0.16-0.20	Low------	5.0-7.0	0.24	0.24	5	4L	86
	14-20	16-22	1.30-1.50	2.00-6.00	0.14-0.18	Low------	1.0-3.0	0.28	0.28			
	20-60	10-16	1.40-1.60	2.00-6.00	0.10-0.15	Low------	0.0-1.0	0.28	0.28			
1176:												
Litchfield------	0-17	10-16	1.30-1.40	2.00-6.00	0.13-0.15	Low------	2.0-4.0	0.20	0.20	3	3	86
	17-33	5-12	1.35-1.50	6.00-20.00	0.09-0.11	Low------	0.0-0.5	0.17	0.17			
	33-60	0-2	1.50-1.65	6.00-20.00	0.05-0.07	Low------	0.0-0.5	0.15	0.15			
1177C:												
Gardencity------	0-13	5-20	1.30-1.40	2.00-6.00	0.16-0.20	Low------	2.0-4.0	0.20	0.20	5	3	86
	13-25	12-18	1.40-1.50	2.00-6.00	0.11-0.17	Low------	0.5-2.0	0.20	0.20			
	25-60	10-20	1.40-1.50	2.00-6.00	0.10-0.17	Low------	0.0-0.5	0.20	0.20			
Bold------------	0-7	12-18	1.40-1.60	0.60-2.00	0.21-0.24	Low------	0.5-2.0	0.43	0.43	5	4L	86
	7-60	12-18	1.10-1.30	0.60-2.00	0.20-0.24	Low------	0.0-0.5	0.43	0.43			
1178:												
Uniongrove------	0-16	20-25	1.20-1.40	2.00-6.00	0.20-0.22	Low------	5.0-7.0	0.24	0.24	5	6	48
	16-30	18-23	1.30-1.50	2.00-6.00	0.15-0.19	Low------	0.0-2.0	0.28	0.28			
	30-60	10-16	1.40-1.60	2.00-6.00	0.10-0.15	Low------	0.0-0.5	0.28	0.28			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
1183:												
Crowriver--------	0-15	14-20	1.20-1.50	2.00-6.00	0.14-0.20	Low------	4.0-6.0	0.20	0.20	5	3	86
	15-22	12-22	1.30-1.50	2.00-6.00	0.12-0.18	Low------	1.0-3.0	0.24	0.24			
	22-60	12-18	1.40-1.60	2.00-6.00	0.10-0.15	Low------	0.0-1.0	0.24	0.24			
1184:												
Corvuso----------	0-19	35-60	1.35-1.55	0.06-0.60	0.13-0.19	High-----	0.0-2.0	0.28	0.28	5	4L	86
	19-26	35-60	1.40-1.60	0.06-0.60	0.13-0.19	High-----	0.0-1.0	0.32	0.32			
	26-60	30-55	1.60-1.80	0.06-0.20	0.11-0.15	High-----	0.0-0.5	0.37	0.37			
1185:												
Gardencity-------	0-19	5-20	1.30-1.40	2.00-6.00	0.16-0.20	Low------	3.0-5.0	0.20	0.20	5	3	86
	19-24	12-18	1.40-1.50	2.00-6.00	0.11-0.17	Low------	0.5-2.0	0.20	0.20			
	24-60	10-20	1.40-1.50	2.00-6.00	0.10-0.17	Low------	0.0-0.5	0.20	0.20			
1186:												
Forestcity-------	0-22	10-18	1.20-1.40	2.00-6.00	0.14-0.16	Low------	4.0-8.0	0.20	0.20	5	3	86
	22-36	18-28	1.30-1.50	0.60-2.00	0.14-0.17	Moderate	2.0-5.0	0.32	0.32			
	36-60	12-28	1.30-1.50	0.60-6.00	0.11-0.17	Moderate	1.0-3.0	0.32	0.32			
	60-65	10-18	1.40-1.60	2.00-6.00	0.10-0.15	Low------	0.0-2.0	0.24	0.24			
Lundlake---------	0-20	20-27	1.20-1.45	0.20-2.00	0.17-0.22	Moderate	5.0-12	0.28	0.28	5	6	48
	20-28	20-30	1.20-1.45	0.20-2.00	0.17-0.22	Moderate	2.0-5.0	0.28	0.28			
	28-46	18-27	1.30-1.50	0.60-2.00	0.15-0.19	Low------	1.0-2.0	0.28	0.28			
	46-60	10-18	1.40-1.60	2.00-6.00	0.10-0.15	Low------	0.0-1.0	0.28	0.28			
1192:												
Crowriver--------	0-13	14-20	1.20-1.50	2.00-6.00	0.14-0.20	Low------	4.0-6.0	0.20	0.20	5	3	86
	13-17	12-22	1.30-1.50	2.00-6.00	0.12-0.18	Low------	1.0-3.0	0.24	0.24			
	17-60	12-18	1.40-1.60	2.00-6.00	0.10-0.15	Low------	0.0-1.0	0.24	0.24			
Lundlake---------	0-22	20-27	1.20-1.45	0.20-2.00	0.17-0.22	Moderate	5.0-12	0.28	0.28	5	6	48
	22-28	20-30	1.20-1.45	0.20-2.00	0.17-0.22	Moderate	2.0-5.0	0.28	0.28			
	28-35	18-27	1.30-1.50	0.60-2.00	0.15-0.19	Low------	1.0-2.0	0.28	0.28			
	35-60	10-18	1.40-1.60	2.00-6.00	0.10-0.15	Low------	0.0-1.0	0.28	0.28			
1193:												
Cosmos-----------	0-15	35-50	1.40-1.50	0.06-0.20	0.16-0.22	High-----	4.0-8.0	0.28	0.28	5	4	86
	15-30	35-60	1.40-1.60	0.06-0.20	0.14-0.19	High-----	0.5-2.0	0.32	0.32			
	30-60	30-55	1.60-1.80	0.06-0.20	0.11-0.15	Moderate	0.0-0.5	0.32	0.32			
1197:												
Cohoctah---------	0-21	5-20	1.20-1.50	2.00-6.00	0.13-0.22	Low------	3.0-15	0.24	0.24	5	3	86
	21-36	5-18	1.45-1.65	2.00-6.00	0.12-0.20	Low------	0.5-1.0	0.28	0.28			
	36-60	2-18	1.45-1.65	2.00-6.00	0.08-0.20	Low------	---	0.28	0.28			
1198B:												
Rohrbeck---------	0-6	3-6	1.50-1.55	6.00-20.00	0.08-0.12	Low------	0.5-2.0	0.17	0.17	5	2	134
	6-25	2-6	1.50-1.55	6.00-20.00	0.07-0.11	Low------	0.5-1.0	0.17	0.17			
	25-41	16-24	1.25-1.45	2.00-6.00	0.15-0.18	Moderate	0.5-1.0	0.37	0.37			
	41-60	12-18	1.35-1.60	2.00-6.00	0.15-0.18	Low------	0.0-0.5	0.37	0.37			
Koronis----------	0-9	6-16	1.25-1.45	2.00-6.00	0.13-0.18	Low------	1.0-4.0	0.24	0.24	5	3	86
	9-28	18-24	1.30-1.50	0.60-6.00	0.15-0.19	Low------	0.0-2.0	0.28	0.28			
	28-60	12-20	1.35-1.60	2.00-6.00	0.11-0.16	Low------	0.0-1.0	0.28	0.28			
1199:												
Klossner---------	0-38	---	0.25-0.45	0.20-6.00	0.35-0.45	---------	25-60	---	---	2	8	---
	38-60	20-35	1.45-1.70	0.20-2.00	0.14-0.22	Moderate	5.0-20	0.28	0.28			
Lundlake---------	0-26	20-27	1.20-1.40	0.20-2.00	0.17-0.22	Moderate	10-20	0.24	0.24	5	8	---
	26-56	20-27	1.20-1.40	0.20-2.00	0.17-0.22	Moderate	5.0-10	0.28	0.28			
	56-60	10-18	1.40-1.60	2.00-6.00	0.10-0.15	Low------	1.0-4.0	0.28	0.28			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Shrink- swell potential	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
								K	Kf	T		
	In	Pct	g/cc	In/hr	In/in		Pct					
1203:												
Muskego----------	0-10	2-4	0.10-0.21	0.20-6.00	0.35-0.45	---------	25-60	0.10	0.10	1	8	---
	10-29	18-35	0.30-1.10	0.60-2.00	0.18-0.24	Moderate	6.0-20	0.28	0.28			
	29-60	22-32	1.35-1.50	0.60-2.00	0.15-0.19	Low------	0.5-2.0	0.32	0.32			
Blue Earth------	0-50	18-32	0.20-0.80	0.60-2.00	0.18-0.24	Moderate	10-25	0.28	0.28	5	6	48
	50-60	18-32	0.20-0.80	0.60-2.00	0.18-0.24	Low------	10-25	0.28	0.28			
Houghton--------	0-60	---	0.08-0.30	0.20-6.00	0.35-0.45	---------	70-99	---	---	3	8	---
1204B:												
Reedslake-------	0-12	20-26	1.30-1.40	0.60-2.00	0.20-0.22	Low------	3.0-5.0	0.24	0.24	5	6	48
	12-26	22-32	1.40-1.50	0.60-2.00	0.15-0.19	Moderate	0.5-2.0	0.32	0.32			
	26-60	20-27	1.45-1.60	0.60-2.00	0.14-0.18	Low------	0.0-1.0	0.37	0.37			
1213C:												
Cokato----------	0-16	22-27	1.30-1.40	0.60-2.00	0.20-0.22	Low------	3.0-5.0	0.28	0.28	5	6	48
	16-41	25-35	1.40-1.50	0.60-2.00	0.15-0.19	Moderate	1.0-2.0	0.37	0.37			
	41-60	20-30	1.45-1.60	0.60-2.00	0.14-0.18	Moderate	0.0-1.0	0.37	0.37			
Storden---------	0-9	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low------	1.0-2.0	0.28	0.28	5	4L	86
	9-18	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
	18-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-0.5	0.37	0.37			
1220C:												
Cokato----------	0-10	22-27	1.30-1.40	0.60-2.00	0.20-0.22	Low------	3.0-5.0	0.28	0.28	5	6	48
	10-29	25-35	1.40-1.50	0.60-2.00	0.15-0.19	Moderate	1.0-2.0	0.37	0.37			
	29-60	20-30	1.45-1.60	0.60-2.00	0.14-0.18	Moderate	0.0-1.0	0.37	0.37			
Storden---------	0-9	18-27	1.35-1.45	0.60-2.00	0.20-0.22	Low------	1.0-2.0	0.28	0.28	5	4L	86
	9-60	18-30	1.35-1.65	0.60-2.00	0.15-0.19	Moderate	0.0-1.0	0.37	0.37			
Hawick----------	0-8	2-10	1.50-1.65	2.00-20.00	0.03-0.13	Low------	1.0-3.0	0.10	0.15	5	8	---
	8-33	1-10	1.50-1.65	6.00-20.00	0.03-0.10	Low------	0.0-0.5	0.10	0.15			
	33-60	1-5	1.55-1.65	20.00-40.00	0.02-0.06	Low------	0.0-0.5	0.10	0.15			
1362B:												
Angus-----------	0-9	20-27	1.30-1.40	0.60-2.00	0.20-0.22	Low------	1.0-4.0	0.28	0.28	5	6	48
	9-35	24-35	1.45-1.55	0.60-2.00	0.15-0.19	Moderate	0.5-1.0	0.28	0.28			
	35-60	22-30	1.55-1.75	0.60-2.00	0.14-0.19	Low------	0.0-0.5	0.37	0.37			
1383A:												
Shorewood-------	0-9	30-40	1.20-1.40	0.20-0.60	0.18-0.22	Moderate	4.0-7.0	0.28	0.28	5	4	86
	9-46	36-55	1.20-1.35	0.06-0.60	0.13-0.16	High-----	1.0-3.0	0.32	0.32			
	46-60	24-45	1.25-1.55	0.20-2.00	0.14-0.16	Moderate	0.0-1.0	0.37	0.37			
1384:												
Minneopa--------	0-7	10-22	1.20-1.40	0.60-2.00	0.18-0.22	Low------	2.0-4.0	0.24	0.24	3	5	56
	7-15	8-18	1.30-1.50	0.60-6.00	0.14-0.19	Low------	0.5-1.0	0.24	0.24			
	15-25	2-6	1.45-1.70	6.00-63.00	0.03-0.08	Low------	0.0-0.5	0.05	0.10			
	25-60	1-5	1.50-1.70	6.00-63.00	0.02-0.06	Low------	0.0-0.5	0.05	0.10			
1385:												
Havelock--------	0-15	20-26	1.40-1.45	0.60-2.00	0.20-0.22	Moderate	5.0-7.0	0.24	0.24	5	4L	86
	15-38	27-35	1.40-1.50	0.60-2.00	0.20-0.22	High-----	1.0-2.0	0.28	0.28			
	38-60	12-26	1.50-1.65	2.00-6.00	0.13-0.17	Low------	0.0-0.5	0.28	0.28			
1387A:												
Collinwood------	0-13	35-40	1.20-1.30	0.20-0.60	0.14-0.17	Moderate	5.0-8.0	0.28	0.28	5	4	86
	13-32	35-60	1.25-1.35	0.06-0.60	0.13-0.16	High-----	1.0-4.0	0.32	0.32			
	32-60	35-45	1.25-1.40	0.06-0.60	0.11-0.15	High-----	0.0-2.0	0.32	0.32			

Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors K	Erosion factors Kf	Erosion factors T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in		Pct					
1391B:												
Wadenill--------	0-9	12-22	1.30-1.50	0.60-2.00	0.20-0.22	Low------	2.0-5.0	0.24	0.24	5	5	56
	9-25	8-18	1.30-1.55	2.00-6.00	0.12-0.19	Low------	1.0-2.0	0.24	0.24			
	25-60	8-18	1.40-1.60	2.00-6.00	0.11-0.19	Low------	0.0-1.0	0.28	0.28			
Sunburg---------	0-7	12-20	1.35-1.55	2.00-6.00	0.16-0.18	Low------	1.0-4.0	0.24	0.24	5	3	86
	7-60	10-18	1.40-1.60	2.00-6.00	0.11-0.19	Low------	0.0-1.0	0.24	0.24			
1406:												
Medo------------	0-20	---	0.25-0.45	0.20-6.00	0.35-0.45	---------	20-50	---	---	2	2	134
	20-28	15-30	1.15-1.65	0.60-6.00	0.13-0.20	Moderate	5.0-20	0.24	0.24			
	28-34	15-30	1.35-1.65	0.60-6.00	0.13-0.20	Moderate	1.0-4.0	0.32	0.32			
	34-60	0-10	1.50-1.65	2.00-20.00	0.03-0.10	Low------	0.5-2.0	0.10	0.10			
Dassel----------	0-14	6-18	1.30-1.45	2.00-6.00	0.16-0.20	Low------	3.0-15	0.20	0.20	4	3	86
	14-31	2-6	1.40-1.60	2.00-6.00	0.12-0.17	Low------	1.0-4.0	0.20	0.20			
	31-60	2-8	1.45-1.65	6.00-20.00	0.08-0.10	Low------	0.0-1.0	0.20	0.20			
Biscay----------	0-10	18-27	1.20-1.30	0.60-2.00	0.20-0.22	Moderate	4.0-8.0	0.28	0.28	4	6	48
	10-29	18-30	1.25-1.35	0.60-2.00	0.17-0.19	Moderate	0.5-1.0	0.28	0.28			
	29-60	1-6	1.55-1.65	6.00-63.00	0.02-0.04	Low------	0.0-0.5	0.05	0.10			
1801B:												
Gardencity------	0-13	5-20	1.30-1.40	2.00-6.00	0.16-0.20	Low------	2.0-4.0	0.20	0.20	5	3	86
	13-34	12-18	1.40-1.50	2.00-6.00	0.11-0.17	Low------	0.5-2.0	0.20	0.20			
	34-60	10-20	1.40-1.50	2.00-6.00	0.10-0.17	Low------	0.0-0.5	0.20	0.20			

Chemical Properties of the Soils

(Absence of an entry indicates that data were not estimated)

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum
	In	Pct	meq/100g	pH	Pct	Pct
8B:						
Sparta----------	0-16	3-10	2.0-12.0	5.1-7.3	---	---
	16-29	1-8	1.0-6.0	5.1-7.3	---	---
	29-60	0-5	1.0-4.0	5.1-7.8	---	---
8C:						
Sparta----------	0-7	3-10	2.0-12.0	5.1-7.3	---	---
	7-13	1-8	1.0-6.0	5.1-7.3	---	---
	13-60	0-5	1.0-4.0	5.1-7.8	---	---
8D:						
Sparta----------	0-9	3-10	2.0-12.0	5.1-7.3	---	---
	9-40	1-8	1.0-6.0	5.1-7.3	---	---
	40-60	0-5	1.0-4.0	5.1-7.8	---	---
35:						
Blue Earth------	0-8	18-32	30.0-70.0	7.4-8.4	5-20	---
	8-60	18-32	30.0-70.0	7.4-8.4	5-40	---
39A:						
Wadena----------	0-13	18-27	5.0-25.0	6.1-7.3	---	---
	13-29	18-30	5.0-20.0	5.6-7.3	---	---
	29-60	1-5	0.0-5.0	6.6-8.4	0-15	---
41A:						
Estherville-----	0-12	5-15	2.0-20.0	5.6-7.3	---	---
	12-15	10-18	4.0-20.0	5.6-7.3	---	---
	15-60	0-8	0.0-5.0	6.6-8.4	0-15	---
85:						
Calco-----------	0-22	28-33	36.0-41.0	7.4-8.4	5-30	---
	22-60	30-35	36.0-41.0	7.4-8.4	5-30	---
86:						
Canisteo--------	0-18	27-35	19.0-37.0	7.4-8.4	5-15	---
	18-26	25-35	12.0-29.0	7.4-8.4	12-18	---
	26-33	25-35	6.0-23.0	7.4-8.4	10-15	---
	33-60	22-30	9.0-20.0	7.4-8.4	10-15	---
96B:						
Collinwood------	0-8	35-40	35.0-42.0	5.6-7.3	---	---
	8-32	35-60	26.0-50.0	5.6-7.3	---	---
	32-60	35-45	25.0-35.0	7.4-8.4	5-15	---
101B:						
Truman----------	0-14	18-27	20.0-35.0	5.6-7.3	---	---
	14-40	18-32	15.0-25.0	5.6-7.8	0-15	---
	40-60	18-32	13.0-23.0	7.4-8.4	5-20	---
102B:						
Clarion---------	0-12	20-27	20.0-25.0	5.6-7.3	---	---
	12-27	23-30	20.0-25.0	5.6-7.8	0-15	---
	27-60	22-30	20.0-25.0	7.4-8.4	5-30	---
106C2:						
Lester----------	0-9	20-27	10.0-24.0	5.6-7.3	---	---
	9-27	24-32	10.0-23.0	5.1-7.3	---	---
	27-60	22-30	8.0-18.0	7.4-8.4	5-30	---

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum
	In	Pct	meq/100g	pH	Pct	Pct
112:						
Harps-----------	0-19	27-35	20.0-30.0	7.9-8.4	20-40	---
	19-25	24-35	15.0-25.0	7.9-8.4	20-30	---
	25-60	22-30	10.0-20.0	7.4-8.4	20-30	---
113:						
Webster---------	0-17	26-35	22.0-32.0	6.6-7.3	---	---
	17-24	25-35	15.0-25.0	6.6-7.8	0-10	---
	24-60	22-30	13.0-20.0	7.4-8.4	5-30	---
114:						
Glencoe---------	0-10	27-35	23.0-37.0	6.1-7.8	0-5	---
	10-34	25-35	16.0-27.0	6.1-7.8	0-5	---
	34-80	25-35	14.0-25.0	6.6-7.8	0-5	---
129:						
Cylinder--------	0-15	22-27	20.0-25.0	5.6-7.3	---	---
	15-31	22-30	20.0-25.0	6.1-7.3	---	---
	31-60	2-12	5.0-10.0	6.6-8.4	0-25	---
130:						
Nicollet--------	0-16	27-35	25.0-40.0	5.6-7.3	---	---
	16-30	25-35	15.0-25.0	5.6-7.8	0-15	---
	30-60	22-30	10.0-20.0	7.4-8.4	5-30	---
134:						
Okoboji---------	0-8	35-42	41.0-45.0	6.1-7.8	0-15	---
	8-28	35-45	41.0-45.0	6.6-7.8	0-15	---
	28-60	25-35	36.0-41.0	6.6-8.4	0-30	---
136:						
Madelia---------	0-16	27-35	27.0-40.0	6.1-7.3	---	---
	16-30	18-35	17.0-32.0	6.6-7.8	---	---
	30-60	18-35	15.0-28.0	7.4-8.4	5-20	---
140:						
Spicer----------	0-14	29-35	28.0-40.0	7.4-8.4	5-30	---
	14-27	18-35	20.0-35.0	7.4-8.4	5-30	---
	27-60	18-35	15.0-30.0	7.4-8.4	5-30	---
143B:						
Chelsea---------	0-6	8-15	5.0-10.0	5.6-7.3	---	---
	6-60	5-10	5.0-10.0	5.1-6.5	---	---
178:						
Granby----------	0-13	8-18	5.0-20.0	5.6-7.3	---	---
	13-26	0-14	1.0-10.0	5.6-7.8	---	---
	26-60	0-10	1.0-3.0	6.6-8.4	---	---
181:						
Litchfield------	0-20	5-10	6.0-14.0	5.1-7.3	---	---
	20-40	5-10	3.0-8.0	5.1-7.3	---	---
	40-60	1-8	1.0-6.0	6.1-7.8	0-5	---
183:						
Dassel----------	0-23	10-24	10.0-50.0	5.6-7.3	---	---
	23-31	2-6	3.0-10.0	5.6-7.3	---	---
	31-60	2-8	1.0-5.0	6.1-7.8	0-5	---
197:						
Kingston--------	0-16	27-32	25.0-35.0	5.6-7.3	---	---
	16-25	18-32	15.0-30.0	5.6-7.8	0-5	---
	25-60	18-32	15.0-25.0	7.4-8.4	5-15	---

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum
	In	Pct	meq/100g	pH	Pct	Pct
211:						
Lura	0-24	45-60	35.0-70.0	6.1-7.8	0-5	---
	24-31	45-60	29.0-54.0	6.1-7.3	---	---
	31-60	28-60	17.0-47.0	6.6-7.8	10-20	---
229:						
Waldorf	0-8	35-40	33.0-48.0	6.1-7.3	---	---
	8-35	40-55	25.0-46.0	6.6-7.8	0-15	---
	35-60	24-45	14.0-37.0	7.4-8.4	15-30	---
239:						
Le Sueur	0-14	28-30	15.0-26.0	5.6-7.3	---	---
	14-33	24-35	11.0-25.0	5.1-7.3	---	---
	33-60	20-30	8.0-18.0	7.4-8.4	5-30	---
281:						
Darfur	0-23	18-25	10.0-20.0	6.1-7.3	---	---
	23-30	13-18	5.0-15.0	6.6-7.8	---	---
	30-60	5-15	1.0-10.0	6.6-8.4	0-15	---
286B:						
Shorewood	0-12	30-40	30.0-45.0	5.6-7.3	---	---
	12-38	36-55	25.0-45.0	5.1-7.3	---	---
	38-60	24-45	12.0-35.0	6.6-7.8	0-15	---
311C2:						
Shorewood	0-6	40-45	35.0-47.0	5.6-7.3	---	---
	6-20	36-55	25.0-45.0	5.1-7.3	---	---
	20-60	24-45	12.0-35.0	6.6-7.8	0-15	---
327A:						
Dickman	0-12	6-18	5.0-15.0	5.6-6.5	---	---
	12-18	6-18	3.0-10.0	5.6-7.3	---	---
	18-60	1-10	0.0-5.0	5.6-7.8	0-5	---
327B:						
Dickman	0-12	6-18	5.0-15.0	5.6-6.5	---	---
	12-30	6-18	3.0-10.0	5.6-7.3	---	---
	30-60	1-10	0.0-5.0	5.6-7.8	0-5	---
399:						
Biscay	0-14	18-27	20.0-35.0	6.1-7.8	0-15	---
	14-25	18-30	12.0-25.0	6.6-7.8	0-15	---
	25-60	1-6	1.0-5.0	7.4-8.4	5-30	---
415:						
Kanaranzi	0-9	18-27	5.0-23.0	5.6-7.3	---	---
	9-18	18-32	5.0-20.0	5.6-7.8	0-10	---
	18-60	0-5	0.0-5.0	7.4-8.4	5-20	---
423:						
Seaforth	0-12	20-30	16.0-27.0	7.4-8.4	5-20	---
	12-28	20-30	10.0-19.0	7.4-8.4	18-30	---
	28-60	20-27	10.0-18.0	7.4-8.4	10-25	---
461B:						
Koronis	0-8	10-20	5.0-20.0	5.6-7.3	---	---
	8-31	18-24	10.0-20.0	5.6-7.3	---	---
	31-60	12-20	5.0-15.0	7.4-8.4	5-20	---

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum
	In	Pct	meq/100g	pH	Pct	Pct
461C2:						
Koronis----------	0-8	10-20	5.0-20.0	5.6-7.3	---	---
	8-24	18-24	10.0-20.0	5.6-7.3	---	---
	24-60	12-20	5.0-15.0	7.4-8.4	5-20	---
511:						
Marcellon--------	0-13	13-20	8.0-30.0	5.6-7.3	---	---
	13-32	20-24	4.0-20.0	5.6-7.3	---	---
	32-60	8-17	2.0-15.0	7.4-8.4	10-25	---
523:						
Houghton---------	0-7	---	140-200	4.5-7.8	---	---
	7-60	---	100-200	4.5-7.8	---	---
525:						
Muskego----------	0-10	---	140-180	5.6-7.3	---	---
	10-40	---	150-190	5.6-7.3	---	---
	40-60	18-35	10.0-45.0	6.6-8.4	60-80	---
539:						
Klossner---------	0-28	---	50-150	5.6-7.8	0-5	---
	28-45	22-35	35.0-65.0	6.1-7.8	0-5	---
	45-60	15-32	5.0-25.0	6.1-8.4	0-20	---
548:						
Medo-------------	0-24	---	40-100	6.1-7.8	0-10	---
	24-29	15-30	20.0-55.0	6.1-7.8	0-5	---
	29-56	15-30	10.0-25.0	6.1-7.8	0-5	---
	56-60	0-10	1.0-9.0	6.1-8.4	0-15	---
610:						
Calco------------	0-6	28-33	36.0-41.0	7.4-8.4	5-30	---
	6-55	30-35	36.0-41.0	7.4-8.4	5-30	---
	55-60	22-32	36.0-41.0	7.4-8.4	5-30	---
611D:						
Hawick-----------	0-7	2-10	1.0-10.0	6.1-7.8	0-10	---
	7-10	1-10	1.0-5.0	6.1-7.8	0-10	---
	10-60	1-5	1.0-5.0	7.4-8.4	5-15	---
612B:						
Wadenill---------	0-13	12-22	15.0-25.0	5.6-7.3	---	---
	13-30	8-18	10.0-20.0	5.6-7.3	0-5	---
	30-60	8-18	5.0-15.0	7.4-8.4	10-20	---
613:						
Grovecity--------	0-15	12-22	15.0-25.0	6.1-7.3	---	---
	15-30	10-18	10.0-20.0	6.1-7.8	0-5	---
	30-60	8-18	5.0-15.0	7.4-8.4	10-20	---
664:						
Zook-------------	0-10	35-40	36.0-41.0	5.6-7.3	---	---
	10-41	36-45	36.0-41.0	5.6-7.8	---	---
	41-60	20-45	30.0-36.0	5.6-7.8	---	---
740:						
Hamel------------	0-28	20-27	15.0-30.0	5.6-7.3	---	---
	28-56	24-35	15.0-30.0	5.6-7.3	---	---
	56-60	20-30	10.0-20.0	7.4-7.8	5-25	---
Glencoe----------	0-15	25-27	22.0-33.0	6.1-7.8	0-5	---
	15-45	25-35	16.0-27.0	6.1-7.8	0-5	---
	45-60	25-35	14.0-25.0	6.6-7.8	0-5	---

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum
	In	Pct	meq/100g	pH	Pct	Pct
804B:						
Koronis----------	0-8	10-20	5.0-20.0	5.6-7.3	---	---
	8-33	18-24	10.0-20.0	5.6-7.3	---	---
	33-60	12-20	5.0-15.0	7.4-8.4	5-20	---
Sunburg----------	0-9	12-20	5.0-15.0	6.6-8.4	0-15	---
	9-60	10-18	5.0-11.0	7.4-8.4	10-30	---
Hawick-----------	0-9	2-10	1.0-10.0	6.1-7.8	0-10	---
	9-49	1-10	1.0-5.0	6.1-7.8	0-10	---
	49-60	1-5	1.0-5.0	7.4-8.4	5-15	---
804C2:						
Koronis----------	0-8	6-16	5.0-15.0	5.6-7.3	---	---
	8-26	18-24	10.0-20.0	5.6-7.3	---	---
	26-60	12-20	5.0-15.0	7.4-8.4	5-20	---
Sunburg----------	0-10	12-20	5.0-15.0	6.6-8.4	0-15	---
	10-60	10-18	5.0-11.0	7.4-8.4	10-30	---
Hawick-----------	0-9	2-10	1.0-10.0	6.1-7.8	0-10	---
	9-60	1-10	1.0-5.0	6.1-7.8	0-10	---
804D2:						
Koronis----------	0-8	6-16	5.0-15.0	5.6-7.3	---	---
	8-25	18-24	10.0-20.0	5.6-7.3	---	---
	25-60	12-20	5.0-15.0	7.4-8.4	5-20	---
Sunburg----------	0-7	12-20	5.0-15.0	6.6-8.4	0-15	---
	7-60	10-18	5.0-11.0	7.4-8.4	10-30	---
Hawick-----------	0-7	2-10	1.0-10.0	6.1-7.8	0-10	---
	7-20	1-10	1.0-5.0	6.1-7.8	0-10	---
	20-60	1-5	1.0-5.0	7.4-8.4	5-15	---
804E:						
Koronis----------	0-5	6-16	5.0-15.0	5.6-7.3	---	---
	5-21	18-24	10.0-20.0	5.6-7.3	---	---
	21-60	12-20	5.0-15.0	7.4-8.4	5-20	---
Sunburg----------	0-4	12-20	5.0-15.0	6.6-8.4	0-15	---
	4-60	10-18	5.0-11.0	7.4-8.4	10-30	---
Hawick-----------	0-14	2-10	1.0-10.0	6.1-7.8	0-10	---
	14-60	1-10	1.0-5.0	6.1-7.8	0-10	---
805C2:						
Sunburg----------	0-8	12-20	5.0-15.0	6.6-8.4	0-15	---
	8-60	10-18	5.0-11.0	7.4-8.4	10-30	---
Wadenill---------	0-7	12-22	15.0-25.0	5.6-7.3	---	---
	7-20	8-18	10.0-20.0	5.6-7.3	0-5	---
	20-60	8-18	5.0-15.0	7.4-8.4	10-20	---
805D2:						
Sunburg----------	0-7	12-20	5.0-15.0	6.6-8.4	0-15	---
	7-60	10-18	5.0-11.0	7.4-8.4	10-30	---
Wadenill---------	0-7	12-22	15.0-25.0	5.6-7.3	---	---
	7-18	8-18	10.0-20.0	5.6-7.3	0-5	---
	18-60	8-18	5.0-15.0	7.4-8.4	10-20	---

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum
	In	Pct	meq/100g	pH	Pct	Pct
807D2:						
Koronis----------	0-9	6-16	5.0-15.0	5.6-7.3	---	---
	9-25	18-24	10.0-20.0	5.6-7.3	---	---
	25-60	12-20	5.0-15.0	7.4-8.4	5-20	---
Sunburg----------	0-7	12-20	5.0-15.0	6.6-8.4	0-15	---
	7-60	10-18	5.0-11.0	7.4-8.4	10-30	---
875B:						
Estherville------	0-9	5-15	2.0-20.0	5.6-7.3	---	---
	9-14	10-18	4.0-20.0	5.6-7.3	---	---
	14-60	0-8	0.0-5.0	6.6-8.4	0-15	---
Hawick-----------	0-7	5-15	1.0-10.0	6.1-7.8	0-10	---
	7-11	1-10	1.0-5.0	6.1-7.8	0-10	---
	11-60	1-5	1.0-5.0	7.4-8.4	5-15	---
875C:						
Hawick-----------	0-11	2-10	1.0-10.0	6.1-7.8	0-10	---
	11-60	1-5	1.0-5.0	7.4-8.4	5-15	---
Estherville------	0-8	5-15	2.0-20.0	5.6-7.3	---	---
	8-13	10-18	4.0-20.0	5.6-7.3	---	---
	13-60	0-8	0.0-5.0	6.6-8.4	0-15	---
887B:						
Clarion----------	0-11	20-27	20.0-25.0	5.6-7.3	---	---
	11-30	23-30	20.0-25.0	5.6-7.8	0-15	---
	30-60	22-30	20.0-25.0	7.4-8.4	5-30	---
Swanlake---------	0-8	18-27	13.0-22.0	7.4-8.4	0-10	---
	8-12	18-30	9.0-19.0	7.4-8.4	10-25	---
	12-60	18-30	9.0-17.0	7.4-8.4	10-25	---
899:						
Harps------------	0-9	27-35	20.0-30.0	7.9-8.4	20-40	---
	9-28	24-35	15.0-25.0	7.9-8.4	20-30	---
	28-60	22-30	10.0-20.0	7.4-8.4	20-30	---
Okoboji----------	0-17	35-42	41.0-45.0	6.1-7.8	0-15	---
	17-47	35-45	41.0-45.0	6.6-7.8	0-15	---
	47-60	25-35	36.0-41.0	6.6-8.4	0-30	---
909C2:						
Bold-------------	0-7	12-18	6.0-15.0	7.4-8.4	10-40	---
	7-60	12-18	5.0-12.0	7.4-8.4	10-50	---
Truman-----------	0-10	18-27	20.0-35.0	5.6-7.3	---	---
	10-31	18-32	15.0-25.0	5.6-7.8	0-15	---
	31-60	18-32	13.0-23.0	7.4-8.4	5-20	---
909D2:						
Bold-------------	0-7	12-18	6.0-15.0	7.4-8.4	10-40	---
	7-60	12-18	5.0-12.0	7.4-8.4	10-50	---
Truman-----------	0-13	18-27	20.0-35.0	5.6-7.3	---	---
	13-22	18-32	15.0-25.0	5.6-7.8	0-15	---
	22-60	18-32	13.0-23.0	7.4-8.4	5-20	---
920B:						
Clarion----------	0-12	20-27	20.0-25.0	5.6-7.3	---	---
	12-23	23-30	20.0-25.0	5.6-7.8	0-15	---
	23-60	22-30	20.0-25.0	7.4-8.4	5-30	---

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum
	In	Pct	meq/100g	pH	Pct	Pct
920B:						
Storden----------	0-7	18-27	11.0-18.0	7.4-8.4	5-30	---
	7-37	18-30	9.0-18.0	7.4-8.4	15-30	---
	37-60	18-30	9.0-18.0	7.4-8.4	10-20	---
Hawick-----------	0-9	2-10	1.0-10.0	6.1-7.8	0-10	---
	9-28	1-10	1.0-5.0	6.1-7.8	0-10	---
	28-60	1-5	1.0-5.0	7.4-8.4	5-15	---
945D2:						
Lester-----------	0-9	20-27	10.0-24.0	5.6-7.3	---	---
	9-26	24-32	10.0-23.0	5.1-7.3	---	---
	26-60	22-30	8.0-18.0	7.4-8.4	5-30	---
Storden----------	0-5	18-27	11.0-18.0	7.4-8.4	5-30	---
	5-28	18-30	9.0-18.0	7.4-8.4	15-30	---
	28-60	18-30	9.0-18.0	7.4-8.4	10-20	---
945E:						
Lester-----------	0-7	20-27	10.0-24.0	5.6-7.3	---	---
	7-23	24-32	10.0-23.0	5.1-7.3	---	---
	23-60	22-30	8.0-18.0	7.4-8.4	5-30	---
Storden----------	0-9	18-27	11.0-18.0	7.4-8.4	5-30	---
	9-30	18-30	9.0-18.0	7.4-8.4	15-30	---
	30-60	18-30	9.0-18.0	7.4-8.4	10-20	---
956:						
Canisteo---------	0-17	27-35	19.0-37.0	7.4-8.4	5-15	---
	17-23	25-35	12.0-29.0	7.4-8.4	12-18	---
	23-41	25-35	6.0-23.0	7.4-8.4	10-15	---
	41-60	22-30	9.0-20.0	7.4-8.4	10-15	---
Glencoe----------	0-7	27-35	23.0-37.0	6.1-7.8	0-5	---
	7-36	25-35	16.0-27.0	6.1-7.8	0-5	---
	36-60	25-35	14.0-25.0	6.6-7.8	0-5	---
960C2:						
Storden----------	0-8	18-27	11.0-18.0	7.4-8.4	5-30	---
	8-21	18-30	9.0-18.0	7.4-8.4	15-30	---
	21-60	18-30	9.0-18.0	7.4-8.4	10-20	---
Omsrud-----------	0-9	20-26	14.0-35.0	5.6-7.3	---	---
	9-25	22-30	9.0-22.0	5.6-7.3	---	---
	25-60	22-30	7.0-16.0	7.4-8.4	5-30	---
960D2:						
Storden----------	0-7	18-27	11.0-18.0	7.4-8.4	5-30	---
	7-23	18-30	9.0-18.0	7.4-8.4	15-30	---
	23-60	18-30	9.0-18.0	7.4-8.4	10-20	---
Omsrud-----------	0-8	20-26	14.0-35.0	5.6-7.3	---	---
	8-22	22-30	9.0-22.0	5.6-7.3	---	---
	22-60	22-30	7.0-16.0	7.4-8.4	5-30	---
978:						
Cordova----------	0-15	27-30	20.0-30.0	6.1-7.3	---	---
	15-39	28-35	15.0-25.0	5.1-6.5	---	---
	39-60	18-30	10.0-17.0	7.4-8.4	5-20	---
Rolfe------------	0-28	22-27	20.0-25.0	5.1-7.3	---	---
	28-40	38-45	20.0-30.0	6.1-7.3	---	---
	40-60	24-35	20.0-25.0	6.1-8.4	0-25	---

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum
	In	Pct	meq/100g	pH	Pct	Pct
1015:						
Udipsamments----	0-14	1-15	1.0-5.0	6.6-7.3	---	---
	14-60	1-10	1.0-3.0	6.6-7.3	---	---
	60-80	1-10	1.0-3.0	7.4-8.4	0-5	---
1016:						
Udorthents------	0-60	2-18	1.0-15.0	6.6-9.0	---	---
	60-80	---	---	---	---	---
1030:						
Pits, gravel.						
Udipsamments----	0-14	1-15	1.0-5.0	6.6-7.3	---	---
	14-60	1-10	1.0-3.0	6.6-7.3	---	---
	60-80	1-10	1.0-3.0	7.4-8.4	0-5	---
1080:						
Klossner--------	0-25	---	50-150	5.1-7.8	0-5	---
	25-60	20-35	20.0-60.0	6.1-8.4	0-20	---
Okoboji---------	0-10	30-40	41.0-50.0	6.1-7.8	0-15	---
	10-42	35-45	41.0-45.0	6.6-7.8	0-15	---
	42-60	35-45	36.0-41.0	6.6-7.8	0-30	---
Glencoe---------	0-42	27-35	20.0-40.0	6.1-7.8	0-5	---
	42-50	25-35	15.0-30.0	6.6-7.8	0-5	---
	50-60	22-32	10.0-20.0	7.4-7.8	5-20	---
1096:						
Fieldon---------	0-20	15-22	15.0-30.0	7.4-8.4	5-30	---
	20-26	10-18	10.0-20.0	7.4-8.4	5-30	---
	26-60	5-15	1.0-10.0	7.4-8.4	5-30	---
Dassel----------	0-21	10-24	10.0-50.0	5.6-7.3	---	---
	21-32	2-6	3.0-10.0	5.6-7.3	---	---
	32-60	2-8	1.0-5.0	6.1-7.8	0-5	---
1097:						
Mayer-----------	0-16	18-30	15.0-31.0	7.4-8.4	5-30	---
	16-25	18-30	13.0-27.0	7.4-8.4	5-30	---
	25-60	1-5	1.0-10.0	7.4-8.4	5-30	---
Biscay----------	0-20	27-30	20.0-35.0	6.1-7.8	0-15	---
	20-25	18-30	12.0-25.0	6.6-7.8	0-15	---
	25-28	10-28	5.0-20.0	6.6-7.8	0-15	---
	28-60	1-6	1.0-5.0	7.4-8.4	5-30	---
1098:						
Biscay----------	0-20	18-30	20.0-35.0	6.1-7.8	0-15	---
	20-25	18-30	12.0-25.0	6.6-7.8	0-15	---
	25-60	1-6	1.0-5.0	7.4-8.4	5-30	---
Biscay, depressional---	0-18	27-30	20.0-35.0	6.1-7.8	0-15	---
	18-22	18-30	12.0-25.0	6.6-7.8	0-15	---
	22-26	10-28	5.0-20.0	6.6-7.8	0-15	---
	26-60	1-6	1.0-5.0	7.4-8.4	5-30	---
1099:						
Granby----------	0-12	2-14	5.0-20.0	5.6-7.3	---	---
	12-24	0-14	1.0-10.0	5.6-7.8	---	---
	24-60	0-10	1.0-3.0	6.6-8.4	---	---

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum
	In	Pct	meq/100g	pH	Pct	Pct
1100:						
Nicollet	0-13	27-35	25.0-40.0	5.6-7.3	---	---
	13-26	25-35	15.0-25.0	5.6-7.8	0-15	---
	26-60	22-30	10.0-20.0	7.4-8.4	5-30	---
1101:						
Webster	0-19	27-35	22.0-32.0	6.6-7.3	---	---
	19-24	25-35	15.0-25.0	6.6-7.8	0-10	---
	24-60	22-30	13.0-20.0	7.4-8.4	5-30	---
1159B:						
Strout	0-10	35-45	25.0-45.0	6.1-7.3	---	---
	10-24	35-50	20.0-40.0	5.6-7.3	---	---
	24-60	30-45	15.0-35.0	7.4-8.4	5-30	---
Arkton	0-9	30-40	25.0-40.0	6.6-8.4	0-30	---
	9-25	30-45	20.0-35.0	7.4-8.4	15-30	---
	25-60	25-40	10.0-30.0	7.4-8.4	5-30	---
1161:						
Barry	0-11	16-23	15.0-26.0	6.1-7.3	---	---
	11-33	18-25	8.0-17.0	6.1-7.3	---	---
	33-60	10-16	4.0-11.0	7.4-7.8	10-20	---
1162A:						
Kandiyohi	0-11	40-50	35.0-50.0	6.1-7.3	---	---
	11-26	35-60	25.0-45.0	6.1-7.3	---	---
	26-33	30-55	20.0-40.0	7.4-8.4	15-30	0-1
	33-60	30-55	20.0-40.0	7.4-8.4	10-20	0-1
1162B:						
Kandiyohi	0-10	40-50	35.0-50.0	6.1-7.3	---	---
	10-23	35-60	25.0-45.0	6.1-7.3	---	---
	23-29	30-55	20.0-40.0	7.4-8.4	15-30	0-1
	29-60	30-55	20.0-40.0	7.4-8.4	10-20	0-1
1163:						
Cohoctah	0-17	7-20	10-20	6.1-7.8	---	---
	17-22	5-18	5-20	6.1-8.4	---	---
	22-60	2-5	1-5	6.1-8.4	---	---
1165:						
Lundlake	0-14	28-35	25.0-42.0	6.6-7.3	---	---
	14-35	20-30	14.0-25.0	6.6-7.3	---	---
	35-47	18-27	10.0-18.0	6.6-7.8	0-10	---
	47-60	10-18	5.0-10.0	7.4-7.8	10-20	---
1168:						
Swedegrove	0-15	14-24	17.0-26.0	7.4-8.4	5-20	---
	15-31	16-22	8.0-13.0	7.4-8.4	5-20	---
	31-60	10-16	5.0-9.0	7.4-8.4	10-25	---
Lundlake	0-12	28-35	25.0-42.0	6.6-7.3	---	---
	12-28	20-30	14.0-25.0	6.6-7.3	---	---
	28-36	18-27	10.0-18.0	6.6-7.8	0-10	---
	36-60	10-18	5.0-10.0	7.4-7.8	10-20	---
1169:						
Corvuso	0-11	35-55	25.0-40.0	7.4-8.4	3-20	---
	11-28	35-60	15.0-30.0	7.4-8.4	15-25	0-2
	28-60	30-55	15.0-30.0	7.4-8.4	10-20	---

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum
	In	Pct	meq/100g	pH	Pct	Pct
1169:						
Lura	0-26	45-60	35.0-70.0	6.1-7.8	0-5	---
	26-60	45-60	29.0-54.0	6.1-7.3	---	---
1171C:						
Newlondon	0-7	30-45	30.0-45.0	6.6-7.8	0-20	---
	7-38	35-45	30.0-45.0	7.4-8.4	10-30	---
	38-60	25-40	10.0-30.0	7.4-8.4	5-25	---
Strout	0-9	35-45	25.0-45.0	6.1-7.3	---	---
	9-23	35-50	20.0-40.0	5.6-7.3	---	---
	23-60	30-45	15.0-35.0	7.4-8.4	5-30	---
1171D:						
Newlondon	0-7	30-45	30.0-45.0	6.6-7.8	0-20	---
	7-38	35-45	30.0-45.0	7.4-8.4	10-30	---
	38-60	25-40	10.0-30.0	7.4-8.4	5-25	---
Strout	0-9	35-45	25.0-45.0	6.1-7.3	---	---
	9-19	35-50	20.0-40.0	5.6-7.3	---	---
	19-60	30-45	15.0-35.0	7.4-8.4	5-30	---
1172C:						
Sparta	0-18	3-10	2.0-12.0	5.1-7.3	---	---
	18-55	1-8	1.0-6.0	5.1-7.3	---	---
	55-60	0-5	1.0-4.0	5.1-7.8	---	---
Gardencity	0-7	5-20	8.0-25.0	6.1-7.3	---	---
	7-24	12-18	3.0-25.0	5.6-7.3	---	---
	24-60	10-20	3.0-25.0	6.1-8.4	0-20	---
1173:						
Muskego	0-45	---	140-180	6.6-7.3	---	---
	45-60	18-35	25.0-45.0	7.4-7.8	2-10	---
Klossner	0-22	---	150-200	5.6-7.8	0-15	---
	22-45	22-35	150-200	6.1-7.8	0-15	---
	45-60	15-32	20.0-50.0	6.1-7.8	0-30	---
1174:						
Danielson	0-9	35-40	25.0-50.0	6.1-7.3	---	---
	9-36	35-45	30.0-45.0	6.1-7.3	---	---
	36-51	35-55	25.0-40.0	6.1-7.3	---	---
	51-60	30-55	15.0-40.0	6.6-8.4	0-20	---
1175:						
Swedegrove	0-14	14-24	17.0-26.0	7.4-8.4	5-20	---
	14-20	16-22	8.0-13.0	7.4-8.4	5-20	---
	20-60	10-16	5.0-9.0	7.4-8.4	10-25	---
1176:						
Litchfield	0-17	10-16	8.0-18.0	6.1-7.3	---	---
	17-33	5-12	2.0-8.0	6.6-7.3	---	---
	33-60	0-2	0.0-2.0	6.6-7.3	---	---
1177C:						
Gardencity	0-13	5-20	8.0-25.0	6.1-7.3	---	---
	13-25	12-18	3.0-25.0	5.6-7.3	---	---
	25-60	10-20	3.0-25.0	6.1-8.4	0-20	---
Bold	0-7	12-18	6.0-15.0	7.4-8.4	10-40	---
	7-60	12-18	5.0-12.0	7.4-8.4	10-50	---

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum
	In	Pct	meq/100g	pH	Pct	Pct
1178:						
Uniongrove------	0-16	20-25	18.0-27.0	6.1-7.3	---	---
	16-30	18-23	8.0-15.0	6.1-7.3	---	---
	30-60	10-16	4.0-10.0	7.4-7.8	10-25	---
1183:						
Crowriver-------	0-15	14-20	15.0-22.0	7.4-8.4	20-30	---
	15-22	12-22	8.0-17.0	7.4-8.4	20-30	---
	22-60	12-18	7.0-11.0	7.4-7.8	10-20	---
1184:						
Corvuso---------	0-19	35-60	15.0-35.0	7.4-8.4	15-25	0-2
	19-26	35-60	15.0-30.0	7.4-8.4	15-25	0-2
	26-60	30-55	15.0-30.0	7.4-8.4	10-20	---
1185:						
Gardencity------	0-19	5-20	15.0-24.0	6.6-7.3	---	---
	19-24	12-18	5.0-20.0	6.1-7.3	---	---
	24-60	10-20	5.0-12.0	6.6-8.4	0-15	---
1186:						
Forestcity------	0-22	10-18	10.0-25.0	6.1-7.3	---	---
	22-36	18-28	15.0-25.0	6.1-7.3	---	---
	36-60	12-28	8.0-20.0	5.6-7.3	---	---
	60-65	10-18	5.0-12.0	7.4-7.8	10-20	0-1
Lundlake--------	0-20	20-27	20.0-38.0	6.6-7.3	---	---
	20-28	20-30	14.0-25.0	6.6-7.3	---	---
	28-46	18-27	10.0-18.0	6.6-7.8	0-10	---
	46-60	10-18	5.0-10.0	7.4-7.8	10-20	---
1192:						
Crowriver-------	0-13	14-20	15.0-22.0	7.4-8.4	20-30	---
	13-17	12-22	8.0-17.0	7.4-8.4	20-30	---
	17-60	12-18	7.0-11.0	7.4-7.8	10-20	---
Lundlake--------	0-22	20-27	20.0-38.0	6.6-7.3	---	---
	22-28	20-30	14.0-25.0	6.6-7.3	---	---
	28-35	18-27	10.0-18.0	6.6-7.8	0-10	---
	35-60	10-18	5.0-10.0	7.4-7.8	10-20	---
1193:						
Cosmos----------	0-15	35-50	30.0-50.0	6.1-7.3	---	---
	15-30	35-60	25.0-45.0	6.1-7.3	---	0-2
	30-60	30-55	15.0-30.0	7.4-8.4	10-20	0-2
1197:						
Cohoctah--------	0-21	5-20	10.0-30.0	6.1-7.8	---	---
	21-36	5-18	5.0-20.0	6.1-8.4	---	---
	36-60	2-18	1.0-10.0	6.1-8.4	---	---
1198B:						
Rohrbeck--------	0-6	3-6	3.0-8.0	6.1-7.3	---	---
	6-25	2-6	2.0-6.0	5.6-6.5	---	---
	25-41	16-24	8.0-17.0	5.6-7.3	---	---
	41-60	12-18	5.0-12.0	7.4-7.8	10-20	---
Koronis---------	0-9	6-16	5.0-15.0	5.6-7.3	---	---
	9-28	18-24	10.0-20.0	5.6-7.3	---	---
	28-60	12-20	5.0-15.0	7.4-8.4	5-20	---

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum
	In	Pct	meq/100g	pH	Pct	Pct
1199:						
Klossner---------	0-38	---	50-150	5.1-7.8	0-5	---
	38-60	20-35	20.0-60.0	6.1-8.4	0-20	---
Lundlake---------	0-26	20-27	30.0-55.0	6.6-7.3	---	---
	26-56	20-27	20.0-34.0	6.6-7.3	---	---
	56-60	10-18	7.0-16.0	6.6-7.8	0-5	---
1203:						
Muskego----------	0-10	2-4	140-180	5.6-7.3	---	---
	10-29	18-35	10.0-45.0	6.6-8.4	60-80	---
	29-60	22-32	5.0-45.0	7.4-8.4	5-35	---
Blue Earth-------	0-50	18-32	30.0-70.0	7.4-8.4	5-20	---
	50-60	18-32	30.0-70.0	7.4-8.4	5-40	---
Houghton---------	0-60	---	150-230	6.6-7.3	---	---
1204B:						
Reedslake--------	0-12	20-26	16.0-23.0	5.6-7.3	---	---
	12-26	22-32	13.0-21.0	5.6-7.3	---	---
	26-60	20-27	10.0-15.0	7.4-7.8	5-25	---
1213C:						
Cokato-----------	0-16	22-27	15.0-25.0	5.6-7.3	---	---
	16-41	25-35	15.0-20.0	5.6-7.3	---	---
	41-60	20-30	10.0-15.0	7.4-8.4	10-20	---
Storden----------	0-9	18-27	11.0-18.0	7.4-8.4	5-30	---
	9-18	18-30	9.0-18.0	7.4-8.4	15-30	---
	18-60	18-30	9.0-18.0	7.4-8.4	10-20	---
1220C:						
Cokato-----------	0-10	22-27	15.0-25.0	5.6-7.3	---	---
	10-29	25-35	15.0-20.0	5.6-7.3	---	---
	29-60	20-30	10.0-15.0	7.4-8.4	10-20	---
Storden----------	0-9	18-27	11.0-18.0	7.4-8.4	5-30	---
	9-60	18-30	9.0-18.0	7.4-8.4	15-30	---
Hawick-----------	0-8	2-10	1.0-10.0	6.1-7.8	0-10	---
	8-33	1-10	1.0-5.0	6.1-7.8	0-10	---
	33-60	1-5	1.0-5.0	7.4-8.4	5-15	---
1362B:						
Angus------------	0-9	20-27	10.0-24.0	5.6-7.3	---	---
	9-35	24-35	10.0-23.0	5.1-7.3	---	---
	35-60	22-30	8.0-18.0	7.4-8.4	5-30	---
1383A:						
Shorewood--------	0-9	30-40	30.0-45.0	5.6-7.3	---	---
	9-46	36-55	25.0-45.0	5.1-7.3	---	---
	46-60	24-45	25.0-35.0	6.6-7.8	0-15	---
1384:						
Minneopa---------	0-7	10-22	10.0-20.0	6.1-7.3	---	---
	7-15	8-18	5.0-10.0	6.1-7.3	---	---
	15-25	2-6	1.0-4.0	6.1-7.3	---	---
	25-60	1-5	0.0-4.0	7.4-8.4	5-25	---

Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum
	In	Pct	meq/100g	pH	Pct	Pct
1385:						
Havelock---------	0-15	20-26	30.0-36.0	7.4-8.4	5-30	---
	15-38	27-35	30.0-36.0	7.4-8.4	5-30	---
	38-60	12-26	10.0-20.0	7.4-8.4	5-30	---
1387A:						
Collinwood------	0-13	35-40	35.0-44.0	5.6-7.3	---	---
	13-32	35-60	26.0-52.0	5.6-7.3	---	---
	32-60	35-45	25.0-35.0	7.4-8.4	5-15	---
1391B:						
Wadenill---------	0-9	12-22	15.0-25.0	5.6-7.3	---	---
	9-25	8-18	10.0-20.0	5.6-7.3	0-5	---
	25-60	8-18	5.0-15.0	7.4-8.4	10-20	---
Sunburg----------	0-7	12-20	5.0-15.0	6.6-8.4	0-15	---
	7-60	10-18	5.0-11.0	7.4-8.4	10-30	---
1406:						
Medo-------------	0-20	---	40-100	6.1-7.8	0-10	---
	20-28	15-30	20.0-55.0	6.1-7.8	0-5	---
	28-34	15-30	10.0-25.0	6.1-7.8	0-5	---
	34-60	0-10	1.0-9.0	6.1-8.4	0-15	---
Dassel-----------	0-14	6-18	10.0-40.0	5.6-7.3	---	---
	14-31	2-6	3.0-10.0	5.6-7.3	---	---
	31-60	2-8	1.0-5.0	6.1-7.8	0-5	---
Biscay-----------	0-10	18-27	20.0-35.0	6.1-7.8	0-15	---
	10-29	18-30	12.0-25.0	6.6-7.8	0-15	---
	29-60	1-6	1.0-5.0	7.4-8.4	5-30	---
1801B:						
Gardencity------	0-13	5-20	8.0-25.0	6.1-7.3	---	---
	13-34	12-18	3.0-25.0	5.6-7.3	---	---
	34-60	10-20	3.0-25.0	6.1-8.4	0-20	---

Water Features

(See text for definitions of terms used in this table. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Map symbol and soil name	Hydrologic group	Flooding			High water table and ponding				
		Frequency	Duration	Months	Water table depth	Kind of water table	Months	Ponding duration	Maximum ponding depth
					Ft				Ft
8B, 8C, 8D:									
Sparta----------	A	None-------	---	---	>6.0	---	---	---	---
35:									
Blue Earth------	B/D	None-------	---	---	0.0-0.5	Apparent---	Jan-Dec	Very long	1.0
39A:									
Wadena----------	B	None-------	---	---	>6.0	---	---	---	---
41A:									
Estherville-----	B	None-------	---	---	>6.0	---	---	---	---
85:									
Calco-----------	B/D	Occasional	Brief-----	Feb-Nov	0.0-1.0	Apparent---	Nov-Jul	---	---
86:									
Canisteo--------	B/D	None-------	---	---	0.5-1.5	Apparent---	Oct-Jul	---	---
96B:									
Collinwood------	C	None-------	---	---	2.5-4.0	Apparent---	Nov-May	---	---
101B:									
Truman----------	B	None-------	---	---	>6.0	---	---	---	---
102B:									
Clarion---------	B	None-------	---	---	3.5-6.0	Apparent---	Nov-Jul	---	---
106C2:									
Lester----------	B	None-------	---	---	>6.0	---	---	---	---
112:									
Harps-----------	B/D	None-------	---	---	0.5-1.5	Apparent---	Nov-Jul	---	---
113:									
Webster---------	B/D	None-------	---	---	0.5-1.5	Apparent---	Nov-Jul	---	---
114:									
Glencoe---------	B/D	None-------	---	---	0.0-0.5	Apparent---	Oct-Jul	Very long	1.0
129:									
Cylinder--------	B	None-------	---	---	2.0-4.0	Apparent---	Nov-Jul	---	---
130:									
Nicollet--------	B	None-------	---	---	2.0-3.5	Apparent---	Mar-Jun	---	---
134:									
Okoboji---------	B/D	None-------	---	---	0.0-1.0	Apparent---	Nov-Jul	Very long	1.0
136:									
Madelia---------	B/D	None-------	---	---	0.5-1.5	Apparent---	Nov-May	---	---
140:									
Spicer----------	B/D	None-------	---	---	0.5-1.5	Apparent---	Nov-Jun	---	---
143B:									
Chelsea---------	A	None-------	---	---	>6.0	---	---	---	---
178:									
Granby----------	A/D	None-------	---	---	0.5-1.5	Apparent---	Nov-Jun	---	---

Water Features--Continued

Map symbol and soil name	Hydro- logic group	Flooding			High water table and ponding				
		Frequency	Duration	Months	Water table depth	Kind of water table	Months	Ponding duration	Maximum ponding depth
					Ft				Ft
181:									
Litchfield------	B	None-------	---	---	2.5-4.0	Apparent---	Mar-Jun	---	---
183:									
Dassel----------	B/D	None-------	---	---	0.0-0.5	Apparent---	Jan-Dec	Very long	1.0
197:									
Kingston--------	B	None-------	---	---	2.5-4.0	Apparent---	Apr-May	---	---
211:									
Lura------------	C/D	None-------	---	---	0.0-0.5	Apparent---	Nov-Jul	Very long	1.0
229:									
Waldorf---------	C/D	None-------	---	---	0.5-1.5	Apparent---	Nov-Jul	---	---
239:									
Le Sueur--------	B	None-------	---	---	2.5-4.0	Apparent---	Nov-May	---	---
281:									
Darfur----------	B/D	None-------	---	---	0.5-1.5	Apparent---	Dec-May	---	---
286B:									
Shorewood-------	C	None-------	---	---	2.5-4.0	Perched----	Apr-Jun	---	---
311C2:									
Shorewood-------	C	None-------	---	---	2.5-4.0	Perched----	Apr-Jun	---	---
327A, 327B:									
Dickman---------	A	None-------	---	---	>6.0	---	---	---	---
399:									
Biscay----------	B/D	None-------	---	---	0.0-0.5	Apparent---	Jan-Dec	Long------	1.0
415:									
Kanaranzi-------	B	None-------	---	---	>6.0	---	---	---	---
423:									
Seaforth--------	B	None-------	---	---	2.5-4.0	Apparent---	Mar-Jun	---	---
461B, 461C2:									
Koronis---------	B	None-------	---	---	>6.0	---	---	---	---
511:									
Marcellon-------	C	None-------	---	---	1.0-2.5	Apparent---	Nov-May	---	---
523:									
Houghton--------	A/D	None-------	---	---	0.0-1.0	Apparent---	Sep-Jun	Very long	1.0
525:									
Muskego---------	A/D	None-------	---	---	0.0-1.0	Apparent---	Nov-Aug	Long------	1.0
539:									
Klossner--------	A/D	None-------	---	---	0.0-0.5	Apparent---	Oct-Jul	Very long	1.0
548:									
Medo------------	A/D	None-------	---	---	0.0-0.5	Apparent---	Nov-May	Very long	1.0
610:									
Calco-----------	B/D	Frequent---	Brief-----	Feb-Nov	0.0-1.0	Apparent---	Nov-Jul	---	---
611D:									
Hawick----------	A	None-------	---	---	>6.0	---	---	---	---

Water Features--Continued

Map symbol and soil name	Hydrologic group	Flooding			High water table and ponding				
		Frequency	Duration	Months	Water table depth	Kind of water table	Months	Ponding duration	Maximum ponding depth
					Ft				Ft
612B:									
Wadenill	B	None	---	---	>6.0	---	---	---	---
613:									
Grovecity	B	None	---	---	2.5-4.0	Apparent	Mar-Jun	---	---
664:									
Zook	C/D	Occasional	Long	Feb-Nov	0.0-1.0	Apparent	Nov-Jul	---	---
740:									
Hamel	C	None	---	---	0.5-1.5	Apparent	Nov-Jun	---	---
Glencoe	B/D	None	---	---	0.0-0.5	Apparent	Oct-Jul	Very long	1.0
804B, 804C2, 804D2, 804E:									
Koronis	B	None	---	---	>6.0	---	---	---	---
Sunburg	B	None	---	---	>6.0	---	---	---	---
Hawick	A	None	---	---	>6.0	---	---	---	---
805C2, 805D2:									
Sunburg	B	None	---	---	>6.0	---	---	---	---
Wadenill	B	None	---	---	>6.0	---	---	---	---
807D2:									
Koronis	B	None	---	---	>6.0	---	---	---	---
Sunburg	B	None	---	---	>6.0	---	---	---	---
875B:									
Estherville	B	None	---	---	>6.0	---	---	---	---
Hawick	A	None	---	---	>6.0	---	---	---	---
875C:									
Hawick	A	None	---	---	>6.0	---	---	---	---
Estherville	B	None	---	---	>6.0	---	---	---	---
887B:									
Clarion	B	None	---	---	3.5-6.0	Apparent	Nov-Jul	---	---
Swanlake	B	None	---	---	>6.0	---	---	---	---
899:									
Harps	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jul	---	---
Okoboji	B/D	None	---	---	0.0-1.0	Apparent	Nov-Jul	Very long	1.0
909C2, 909D2:									
Bold	B	None	---	---	>6.0	---	---	---	---
Truman	B	None	---	---	>6.0	---	---	---	---
920B:									
Clarion	B	None	---	---	3.5-6.0	Apparent	Nov-Jul	---	---
Storden	B	None	---	---	>6.0	---	---	---	---
Hawick	A	None	---	---	>6.0	---	---	---	---

Water Features--Continued

Map symbol and soil name	Hydrologic group	Flooding			High water table and ponding				
		Frequency	Duration	Months	Water table depth	Kind of water table	Months	Ponding duration	Maximum ponding depth
					Ft				Ft
945D2, 945E:									
Lester----------	B	None-------	---	---	>6.0	---	---	---	---
Storden---------	B	None-------	---	---	>6.0	---	---	---	---
956:									
Canisteo--------	B/D	None-------	---	---	0.5-1.5	Apparent---	Oct-Jul	---	---
Glencoe---------	B/D	None-------	---	---	0.0-0.5	Apparent---	Oct-Jul	Very long	1.0
960C2, 960D2:									
Storden---------	B	None-------	---	---	>6.0	---	---	---	---
Omsrud----------	B	None-------	---	---	>6.0	---	---	---	---
978:									
Cordova---------	C/D	None-------	---	---	0.5-1.5	Apparent---	Nov-Jun	---	---
Rolfe-----------	C	None-------	---	---	0.0-1.0	Apparent---	Nov-Jul	Long------	1.0
1015:									
Udipsamments----	A	None-------	---	---	>6.0	---	---	---	---
1016:									
Udorthents------	B	None-------	---	---	>6.0	---	---	---	---
1030:									
Pits, gravel.									
Udipsamments----	A	None-------	---	---	>6.0	---	---	---	---
1080:									
Klossner--------	D	None-------	---	---	0.0-0.0	Apparent---	Jan-Dec	Very long	3.0
Okoboji---------	D	None-------	---	---	0.0-1.0	Apparent---	Jan-Dec	Very long	3.0
Glencoe---------	D	None-------	---	---	0.0-0.0	Apparent---	Jan-Dec	Very long	3.0
1096:									
Fieldon---------	B/D	None-------	---	---	0.5-1.5	Apparent---	Nov-Jun	---	---
Dassel----------	B/D	None-------	---	---	0.0-0.5	Apparent---	Jan-Dec	Long------	1.0
1097:									
Mayer-----------	B/D	None-------	---	---	0.5-1.5	Apparent---	Oct-Jun	---	---
Biscay----------	B/D	None-------	---	---	0.0-0.5	Apparent---	Jan-Dec	Long------	1.0
1098:									
Biscay----------	B/D	None-------	---	---	0.5-1.5	Apparent---	Nov-Jun	---	---
Biscay, depressional---	B/D	None-------	---	---	0.0-0.5	Apparent---	Jan-Dec	Long------	1.0
1099:									
Granby----------	A/D	None-------	---	---	0.0-1.0	Apparent---	Nov-Jun	Long------	1.0
1100:									
Nicollet--------	B	None-------	---	---	2.0-3.5	Apparent---	Mar-Jun	---	---
1101:									
Webster---------	B/D	None-------	---	---	0.5-1.5	Apparent---	Nov-Jul	---	---

Water Features--Continued

Map symbol and soil name	Hydrologic group	Flooding			High water table and ponding				
		Frequency	Duration	Months	Water table depth	Kind of water table	Months	Ponding duration	Maximum ponding depth
					Ft				Ft
1159B:									
Strout	C	None	---	---	2.5-4.0	Perched	Nov-Jul	---	---
Arkton	C	None	---	---	2.5-4.0	Perched	Nov-Jul	---	---
1161:									
Barry	B/D	None	---	---	1.0-2.5	Apparent	Nov-Jul	---	---
1162A, 1162B:									
Kandiyohi	C/D	None	---	---	1.5-2.5	Perched	Nov-Jul	---	---
1163:									
Cohoctah	B/D	Frequent	Long	Nov-Apr	0.0-1.0	Apparent	Sep-May	---	---
1165:									
Lundlake	B/D	None	---	---	0.0-0.5	Apparent	Nov-Jul	Very long	1.0
1168:									
Swedegrove	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jul	---	---
Lundlake	B/D	None	---	---	0.0-0.5	Apparent	Nov-Jul	Very long	1.0
1169:									
Corvuso	C/D	None	---	---	0.5-1.5	Perched	Nov-Jul	---	---
Lura	C/D	None	---	---	0.0-0.5	Apparent	Nov-Jul	Very long	1.0
1171C, 1171D:									
Newlondon	C	None	---	---	2.5-4.0	Perched	Nov-Jul	---	---
Strout	C	None	---	---	2.5-4.0	Perched	Nov-Jul	---	---
1172C:									
Sparta	A	None	---	---	>6.0	---	---	---	---
Gardencity	B	None	---	---	>6.0	---	---	---	---
1173:									
Muskego	A/D	Frequent	Long	Apr-Jul	0.0-1.6	Apparent	Nov-Aug	Long	3.0
Klossner	A/D	Frequent	Brief	Apr-Nov	0.0-1.0	Apparent	Oct-Jul	Very long	1.0
1174:									
Danielson	C/D	None	---	---	0.5-1.5	Perched	Nov-Jul	---	---
1175:									
Swedegrove	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jul	---	---
1176:									
Litchfield	B	None	---	---	2.5-4.0	Apparent	Mar-Jun	---	---
1177C:									
Gardencity	B	None	---	---	>6.0	---	---	---	---
Bold	B	None	---	---	>6.0	---	---	---	---
1178:									
Uniongrove	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jul	---	---
1183:									
Crowriver	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jul	---	---

Water Features--Continued

Map symbol and soil name	Hydro-logic group	Flooding			High water table and ponding				
		Frequency	Duration	Months	Water table depth	Kind of water table	Months	Ponding duration	Maximum ponding depth
					Ft				Ft
1184:									
Corvuso	C/D	None	---	---	0.5-1.5	Perched	Nov-Jul	---	---
1185:									
Gardencity	B	None	---	---	3.5-6.0	Apparent	Nov-Jul	---	---
1186:									
Forestcity	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jul	---	---
Lundlake	B/D	None	---	---	0.0-0.5	Apparent	Nov-Jul	Very long	1.0
1192:									
Crowriver	B/D	None	---	---	0.5-1.5	Apparent	Nov-Jul	---	---
Lundlake	B/D	None	---	---	0.0-0.5	Apparent	Nov-Jul	Very long	1.0
1193:									
Cosmos	C/D	None	---	---	0.5-1.5	Perched	Nov-Jul	---	---
1197:									
Cohoctah	B/D	Occasional	Long	Nov-Apr	0.0-1.0	Apparent	Sep-May	---	---
1198B:									
Rohrbeck	B	None	---	---	2.5-4.0	Apparent	Apr-Jul	---	---
Koronis	B	None	---	---	>6.0	---	---	---	---
1199:									
Klossner	D	None	---	---	0.0-0.0	Apparent	Jan-Dec	Very long	3.0
Lundlake	D	None	---	---	0.0-0.0	Apparent	Jan-Dec	Very long	3.0
1203:									
Muskego	D	None	---	---	---	Apparent	Jan-Dec	Long	3.0
Blue Earth	B/D	None	---	---	0.0-0.0	Apparent	Jan-Dec	Very long	3.0
Houghton	D	None	---	---	0.0-0.5	Apparent	Sep-Jun	Very long	2.0
1204B:									
Reedslake	B	None	---	---	3.5-6.0	Apparent	Mar-Jun	---	---
1213C:									
Cokato	B	None	---	---	>6.0	---	---	---	---
Storden	B	None	---	---	>6.0	---	---	---	---
1220C:									
Cokato	B	None	---	---	>6.0	---	---	---	---
Storden	B	None	---	---	>6.0	---	---	---	---
Hawick	A	None	---	---	>6.0	---	---	---	---
1362B:									
Angus	B	None	---	---	3.5-6.0	Apparent	Mar-Jun	---	---
1383A:									
Shorewood	C	None	---	---	1.5-2.5	Perched	Apr-Jun	---	---
1384:									
Minneopa	B	None	---	---	3.0-5.0	Apparent	Nov-Jun	---	---

Water Features--Continued

Map symbol and soil name	Hydro-logic group	Flooding			High water table and ponding				
		Frequency	Duration	Months	Water table depth	Kind of water table	Months	Ponding duration	Maximum ponding depth
					Ft				Ft
1385:									
Havelock	B/D	Frequent	Brief	Feb-Nov	0.0-1.0	Apparent	Nov-Jul	---	---
1387A:									
Collinwood	C	None	---	---	1.5-2.5	Perched	Apr-Jun	---	---
1391B:									
Wadenill	B	None	---	---	>6.0	---	---	---	---
Sunburg	B	None	---	---	>6.0	---	---	---	---
1406:									
Medo	A/D	None	---	---	0.0-0.5	Apparent	Nov-May	Very long	1.0
Dassel	B/D	None	---	---	0.0-0.5	Apparent	Jan-Dec	Very long	1.0
Biscay	B/D	None	---	---	0.0-0.5	Apparent	Jan-Dec	Long	1.0
1801B:									
Gardencity	B	None	---	---	>6.0	---	---	---	---

Soil Features

Map symbol and soil name	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
8B, 8C, 8D:							
Sparta----------	>60	---	---	---	Low---------	Low---------	Moderate.
35:							
Blue Earth------	>60	---	---	---	High--------	High--------	Low.
39A:							
Wadena----------	>60	---	---	---	Low---------	Low---------	Low.
41A:							
Estherville-----	>60	---	---	---	Low---------	Low---------	Low.
85:							
Calco-----------	>60	---	---	---	High--------	High--------	Low.
86:							
Canisteo--------	>60	---	---	---	High--------	High--------	Low.
96B:							
Collinwood------	>60	---	---	---	High--------	High--------	Low.
101B:							
Truman----------	>60	---	---	---	High--------	Low---------	Low.
102B:							
Clarion---------	>60	---	---	---	Moderate----	Low---------	Low.
106C2:							
Lester----------	>60	---	---	---	Moderate----	Low---------	Moderate.
112:							
Harps-----------	>60	---	---	---	High--------	High--------	Low.
113:							
Webster---------	>60	---	---	---	High--------	High--------	Low.
114:							
Glencoe---------	>60	---	---	---	High--------	High--------	Low.
129:							
Cylinder--------	>60	---	---	---	High--------	Moderate----	Low.
130:							
Nicollet--------	>60	---	---	---	High--------	High--------	Low.
134:							
Okoboji---------	>60	---	---	---	High--------	High--------	Low.
136:							
Madelia---------	>60	---	---	---	High--------	High--------	Low.
140:							
Spicer----------	>60	---	---	---	High--------	High--------	Low.
143B:							
Chelsea---------	>60	---	---	---	Low---------	Low---------	Low.
178:							
Granby----------	>60	---	---	---	Moderate----	High--------	Low.
181:							
Litchfield------	>60	---	---	---	Moderate----	Low---------	Low.

Soil Features--Continued

Map symbol and soil name	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
183:							
Dassel	>60	---	---	---	High	High	Low.
197:							
Kingston	>60	---	---	---	High	High	Low.
211:							
Lura	>60	---	---	---	High	High	Low.
229:							
Waldorf	>60	---	---	---	High	High	Low.
239:							
Le Sueur	>60	---	---	---	High	High	Low.
281:							
Darfur	>60	---	---	---	High	High	Low.
286B:							
Shorewood	>60	---	---	---	High	High	Moderate.
311C2:							
Shorewood	>60	---	---	---	High	High	Moderate.
327A, 327B:							
Dickman	>60	---	---	---	Low	Low	Moderate.
399:							
Biscay	>60	---	---	---	High	Moderate	Low.
415:							
Kanaranzi	>60	---	---	---	Moderate	Moderate	Low.
423:							
Seaforth	>60	---	---	---	High	High	Low.
461B, 461C2:							
Koronis	>60	---	---	---	Moderate	Low	Moderate.
511:							
Marcellon	>60	---	---	---	High	High	Moderate.
523:							
Houghton	>60	---	6-18	55-60	High	High	Moderate.
525:							
Muskego	>60	---	---	35-45	High	Moderate	Moderate.
539:							
Klossner	>60	---	2-4	25-32	High	High	Moderate.
548:							
Medo	>60	---	2-4	25-32	High	High	Moderate.
610:							
Calco	>60	---	---	---	High	High	Low.
611D:							
Hawick	>60	---	---	---	Low	Low	Low.
612B:							
Wadenill	>60	---	---	---	Moderate	Low	Low.

Soil Features--Continued

Map symbol and soil name	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
613:							
Grovecity--------	>60	---	---	---	High---------	Moderate-----	Low.
664:							
Zook-------------	>60	---	---	---	High---------	High---------	Moderate.
740:							
Hamel------------	>60	---	---	---	High---------	High---------	Low.
Glencoe----------	>60	---	---	---	High---------	High---------	Low.
804B, 804C2, 804D2, 804E:							
Koronis----------	>60	---	---	---	Moderate-----	Low----------	Moderate.
Sunburg----------	>60	---	---	---	Moderate-----	Low----------	Low.
Hawick-----------	>60	---	---	---	Low----------	Low----------	Low.
805C2, 805D2:							
Sunburg----------	>60	---	---	---	Moderate-----	Low----------	Low.
Wadenill---------	>60	---	---	---	Moderate-----	Low----------	Low.
807D2:							
Koronis----------	>60	---	---	---	Moderate-----	Low----------	Moderate.
Sunburg----------	>60	---	---	---	Moderate-----	Low----------	Low.
875B:							
Estherville------	>60	---	---	---	Low----------	Low----------	Low.
Hawick-----------	>60	---	---	---	Low----------	Low----------	Low.
875C:							
Hawick-----------	>60	---	---	---	Low----------	Low----------	Low.
Estherville------	>60	---	---	---	Low----------	Low----------	Low.
887B:							
Clarion----------	>60	---	---	---	Moderate-----	Low----------	Low.
Swanlake---------	>60	---	---	---	Moderate-----	Low----------	Low.
899:							
Harps------------	>60	---	---	---	High---------	High---------	Low.
Okoboji----------	>60	---	---	---	High---------	High---------	Low.
909C2, 909D2:							
Bold-------------	>60	---	---	---	High---------	Low----------	Low.
Truman-----------	>60	---	---	---	High---------	Low----------	Low.
920B:							
Clarion----------	>60	---	---	---	Moderate-----	Low----------	Low.
Storden----------	>60	---	---	---	Moderate-----	Low----------	Low.
Hawick-----------	>60	---	---	---	Low----------	Low----------	Low.

Soil Features--Continued

Map symbol and soil name	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
945D2, 945E:							
Lester	>60	---	---	---	Moderate	Low	Moderate.
Storden	>60	---	---	---	Moderate	Low	Low.
956:							
Canisteo	>60	---	---	---	High	High	Low.
Glencoe	>60	---	---	---	High	High	Low.
960C2, 960D2:							
Storden	>60	---	---	---	Moderate	Low	Low.
Omsrud	>60	---	---	---	Moderate	Low	Low.
978:							
Cordova	>80	---	---	---	High	High	Low.
Rolfe	>60	---	---	---	High	High	Moderate.
1015:							
Udipsamments	>60	---	---	---	Low	Low	Low.
1016:							
Udorthents	>60	---	---	---	Moderate	High	Moderate.
1030:							
Pits, gravel.							
Udipsamments	>60	---	---	---	Low	Low	Low.
1080:							
Klossner	>60	---	2-4	25-32	High	High	Moderate.
Okoboji	>60	---	---	---	High	High	Low.
Glencoe	>60	---	---	---	High	High	Low.
1096:							
Fieldon	>60	---	---	---	High	High	Low.
Dassel	>60	---	---	---	High	High	Low.
1097:							
Mayer	>60	---	---	---	High	High	Low.
Biscay	>60	---	---	---	High	Moderate	Low.
1098:							
Biscay	>60	---	---	---	High	Moderate	Low.
Biscay, depressional	>60	---	---	---	High	Moderate	Low.
1099:							
Granby	>60	---	---	---	Moderate	High	Low.
1100:							
Nicollet	>60	---	---	---	High	High	Low.
1101:							
Webster	>60	---	---	---	High	High	Low.

Soil Features--Continued

Map symbol and soil name	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
1159B:							
Strout	>60	---	---	---	Moderate	High	Low.
Arkton	>60	---	---	---	High	High	Low.
1161:							
Barry	>60	---	---	---	High	High	Low.
1162A, 1162B:							
Kandiyohi	>60	---	---	---	High	High	Low.
1163:							
Cohoctah	>60	---	---	---	High	High	Low.
1165:							
Lundlake	>80	---	---	---	High	High	Low.
1168:							
Swedegrove	>60	---	---	---	High	Moderate	Low.
Lundlake	>80	---	---	---	High	High	Low.
1169:							
Corvuso	>60	---	---	---	High	High	Low.
Lura	>60	---	---	---	High	High	Low.
1171C, 1171D:							
Newlondon	>60	---	---	---	High	High	Low.
Strout	>60	---	---	---	Moderate	High	Low.
1172C:							
Sparta	>60	---	---	---	Low	Low	Moderate.
Gardencity	>80	---	---	---	Moderate	Low	Low.
1173:							
Muskego	>60	---	---	30-40	High	Moderate	Moderate.
Klossner	>60	---	---	25-32	High	High	Moderate.
1174:							
Danielson	>80	---	---	---	High	High	Low.
1175:							
Swedegrove	>60	---	---	---	High	Moderate	Low.
1176:							
Litchfield	>60	---	---	---	Moderate	Low	Low.
1177C:							
Gardencity	>80	---	---	---	Moderate	Low	Low.
Bold	>60	---	---	---	High	Low	Low.
1178:							
Uniongrove	>60	---	---	---	High	Moderate	Low.
1183:							
Crowriver	>60	---	---	---	High	Moderate	Low.

Soil Features--Continued

Map symbol and soil name	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
1184:							
Corvuso	>60	---	---	---	High	High	Low.
1185:							
Gardencity	>60	---	---	---	High	Low	Low.
1186:							
Forestcity	>60	---	---	---	High	Moderate	Low.
Lundlake	>80	---	---	---	High	High	Low.
1192:							
Crowriver	>60	---	---	---	High	Moderate	Low.
Lundlake	>80	---	---	---	High	High	Low.
1193:							
Cosmos	>60	---	---	---	High	High	Low.
1197:							
Cohoctah	>60	---	---	---	High	High	Low.
1198B:							
Rohrbeck	>60	---	---	---	Low	Low	Moderate.
Koronis	>60	---	---	---	Moderate	Low	Moderate.
1199:							
Klossner	>60	---	2-4	25-32	High	High	Moderate.
Lundlake	>80	---	---	---	High	High	Low.
1203:							
Muskego	>60	---	---	30-40	High	Moderate	Moderate.
Blue Earth	>60	---	---	---	High	High	Low.
Houghton	>60	---	---	40-60	High	High	Low.
1204B:							
Reedslake	>60	---	---	---	Moderate	Low	Low.
1213C:							
Cokato	>60	---	---	---	Moderate	Low	Low.
Storden	>60	---	---	---	Moderate	Low	Low.
1220C:							
Cokato	>60	---	---	---	Moderate	Low	Low.
Storden	>60	---	---	---	Moderate	Low	Low.
Hawick	>60	---	---	---	Low	Low	Low.
1362B:							
Angus	>80	---	---	---	Moderate	Low	Moderate.
1383A:							
Shorewood	>60	---	---	---	High	High	Moderate.
1384:							
Minneopa	>60	---	---	---	Moderate	Low	Low.

Soil Features--Continued

Map symbol and soil name	Bedrock		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Initial	Total		Uncoated steel	Concrete
	In		In	In			
1385:							
Havelock--------	>60	---	---	---	High--------	High--------	Low.
1387A:							
Collinwood------	>60	---	---	---	High--------	High--------	Low.
1391B:							
Wadenill--------	>60	---	---	---	Moderate----	Low---------	Low.
Sunburg---------	>60	---	---	---	Moderate----	Low---------	Low.
1406:							
Medo------------	>60	---	2-4	25-32	High--------	High--------	Moderate.
Dassel----------	>60	---	---	---	High--------	High--------	Low.
Biscay----------	>60	---	---	---	High--------	Moderate----	Low.
1801B:							
Gardencity------	>80	---	---	---	Moderate----	Low---------	Low.

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Glossary

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Backslope. The geomorphic component that forms the steepest inclined surface and principal element of many hillslopes. Backslopes in profile are commonly steep and linear and descend to a footslope. In terms of gradational process, backslopes are erosional forms produced mainly by mass wasting and running water.

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Channery soil material. Soil material that is, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage. Any tillage and planting system in which a cover of crop residue is maintained on at least 30 percent of the surface after planting in order to reduce the hazard of water erosion; in areas where soil blowing is the primary concern, a system that maintains a cover of at least 1,000 pounds of flat residue of small grain or its equivalent during the critical erosion period.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—Readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Delta. A body of alluvium having a surface that is nearly flat and fan shaped; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth, soil. The thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—These soils have very high and high hydraulic conductivity and a low water-holding capacity. They are not suited to crop production unless irrigated.

Somewhat excessively drained.—These soils have high hydraulic conductivity and a low water-holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.

Well drained.—These soils have an intermediate or high water-holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.

Moderately well drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of most field crops are affected. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

Somewhat poorly drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted under natural conditions. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

Poorly drained.—These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poor drainage is caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

Very poorly drained.—These soils are wet to the surface most of the time. The wetness prevents the growth of important crops (except for rice) under natural conditions.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. The term is more often applied to cliffs resulting from differential erosion.

Esker. A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field* *capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, or clay.

Firebreak. An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to inundation under flood-stage conditions unless protected artificially. It is generally a constructional landform consisting of sediment deposited during overflow and lateral migration of the stream.

Footslope. The geomorphic component that forms the inner, gently inclined surface at the base of a hillslope. The surface is dominantly concave. In terms of gradational processes, a footslope is a transition zone between an upslope site of erosion (backslope) and a downslope site of deposition (toeslope).

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Geomorphology. The science that treats the general configuration of the earth's surface; specifically the study of the classification, description, nature, origin, and development of landforms and their relationships to underlying structures, and the history of geologic changes as recorded by these surface features. The term is especially applied to the genetic interpretation of landforms.

Glacial drift. Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash. Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glaciofluvial deposits. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water. Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-chroma zones. Zones having chroma of 3 or more. Typical color in areas of iron concentrations.

High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 6 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Ice-walled lake plain. A relict surface marking the floor of an extinct lake basin that was formed on solid ground and surrounded by stagnant ice in a stable or unstable superglacial environment on stagnation moraines. As the ice melted, the lake plain became perched above the adjacent landscape. The lake plain is well sorted, generally fine textured, stratified deposits.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Iron concentrations. High-chroma zones having a high content of iron and manganese oxide because of chemical oxidation and accumulation, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic concentration.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame. An irregular, short ridge or hill of stratified glacial drift.

Karst (topography). The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake bed. The bottom of a lake; a lake basin.

Lake plain. A nearly level surface marking the floor of an extinct lake filled by well sorted, generally fine textured, stratified deposits, commonly containing varves.

Lakeshore. A narrow strip of land in contact with or bordering a lake; especially the beach of a lake.

Lake terrace. A narrow shelf, partly cut and partly built, produced along a lakeshore in front of a scarp line of low cliffs and later exposed when the water level falls.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low-chroma zones. Zones having chroma of 2 or less. Typical color in areas of iron depletions.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine. An accumulation of glacial drift in a topographic landform resulting chiefly from the direct action of glacial ice. Some types are lateral, recessional, and terminal.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mudstone. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Outwash plain. An extensive area of glaciofluvial material that was deposited by meltwater streams.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment. A thin layer of alluvial material that mantles an erosion surface and has been transported to its present position from higher lying areas of the erosion surface.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Extremely slow	less than 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	less than 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Salty water (in tables). Water that is too salty for consumption by livestock.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saprolite. Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Second bottom. The first terrace above the normal flood plain (or first bottom) of a river.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder. The hillslope position that forms the uppermost inclined surface near the top of a hillslope. It comprises the transition zone from backslope to summit. The surface is dominantly convex in profile and erosional in orgin.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Sloughed till. Water-saturated till that has flowed slowly downhill from its original place of deposit by glacial ice. It may rest on other till, on glacial outwash, or on a glaciolacustrine deposit.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of rock fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are: *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter or loosen a layer that restricts roots.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summit. The topographically highest position of a hillslope profile and exhibiting a nearly level surface. A general term for the top, or highest level of a landform, such as a hill, mountain, or tableland. It usually refers to a high interfluve area of gentler slope that is flanked by steeper hillslopes, for example, mountain fronts or tableland escarpments.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Swale. A slight depression in the midst of generally level land. A shallow depression in an undulating ground moraine due to uneven glacial deposition.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till. Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Till plain. An extensive area of nearly level to undulating or gently sloping soils that are underlain by till or consist of till. Slopes are 0 to 6 percent.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope. The outermost inclined surface at the base of a hill. Toeslopes are commonly gentle and linear in profile.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as salts, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The uprooting and tipping over of trees by the wind.

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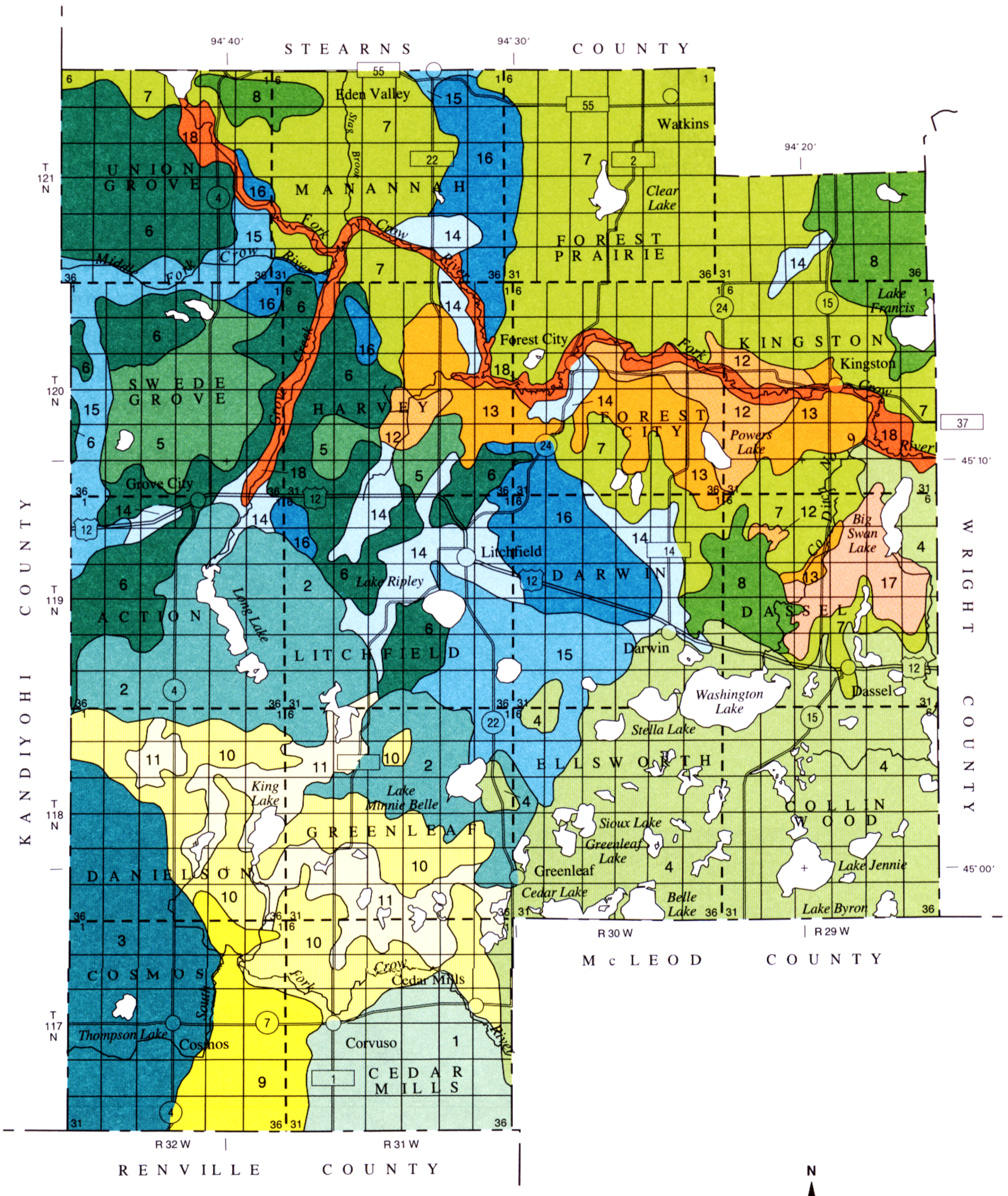
STEARNS COUNTY
94° 40'
94° 30'
94° 20'
Eden Valley
Watkins
UNION GROVE
MANANNAH
FOREST PRAIRIE
Clear Lake
Middle Fork Crow River
Sag Brook
Lake Francis
Kingston
KINGSTON
Forest City
FOREST CITY
SWEDE GROVE
HARVEY
Grove City
Powers Lake
Big Swan Lake
ACTON
Long Lake
Lake Ripley
Litchfield
LITCHFIELD
DARWIN
DASSEL
Darwin
Dassel
Washington Lake
Stella Lake
ELLSWORTH
King Lake
Lake Minnie Belle
GREENLEAF
COLLINWOOD
Sioux Lake
Greenleaf Lake
Greenleaf
Cedar Lake
Belle Lake
Lake Jennie
Lake Byron
DANIELSON
COSMOS
Thompson Lake
Cosmos
Cedar Mills
Corvuso
CEDAR MILLS
South Fork Crow River
T 121 N
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T 118 N
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R 32 W
R 31 W
R 30 W
R 29 W
45° 10'
45° 00'
KANDIYOHI COUNTY
WRIGHT COUNTY
McLEOD COUNTY
RENVILLE COUNTY
N

SOIL LEGEND*

ORGANIC SOILS AND NEARLY LEVEL TO MODERATELY STEEP, LOAMY SOILS THAT FORMED IN TILL; ON MORAINES

1 Canisteo-Okoboji-Nicollet Association
2 Clarion-Hamel-Storden Association
3 Harps-Nicollet-Webster Association
4 Cokato-Storden-Muskego Association
5 Swedegrove-Grovecity-Lundlake Association
6 Wadenill-Swedegrove-Muskego Association
7 Koronis-Forestcity-Houghton Association
8 Koronis-Houghton-Forestcity Association

NEARLY LEVEL TO MODERATELY STEEP, SILTY, CLAYEY, AND LOAMY SOILS THAT FORMED IN TILL; ON MORAINES

9 Cosmos-Kandiyohi-Corvuso Association
10 Cosmos-Strout-Kandiyohi Association
11 Danielson-Newlondon-Strout Association

NEARLY LEVEL TO STRONGLY SLOPING, SILTY SOILS THAT FORMED IN LACUSTRINE DEPOSITS; ON LAKE PLAINS

12 Collinwood-Waldorf-Shorewood Association
13 Madelia-Truman-Kingston Association

NEARLY LEVEL TO HILLY, LOAMY AND SANDY SOILS; ON OUTWASH PLAINS, TERRACES, AND DELTAS

14 Sparta-Darfur-Litchfield Association
15 Kanaranzi-Estherville-Biscay Association
16 Fieldon-Litchfield-Dassel Association
17 Hawick-Estherville Association

SOILS ON FLOOD PLAINS AND TERRACES

18 Cohoctah-Muskego-Estherville Association

*The units on this legend are described in the text under the heading "General Soil Map Units."

Compiled 1994

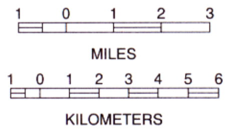
SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
MINNESOTA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
MEEKER COUNTY, MINNESOTA

Scale 1:253440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MILES
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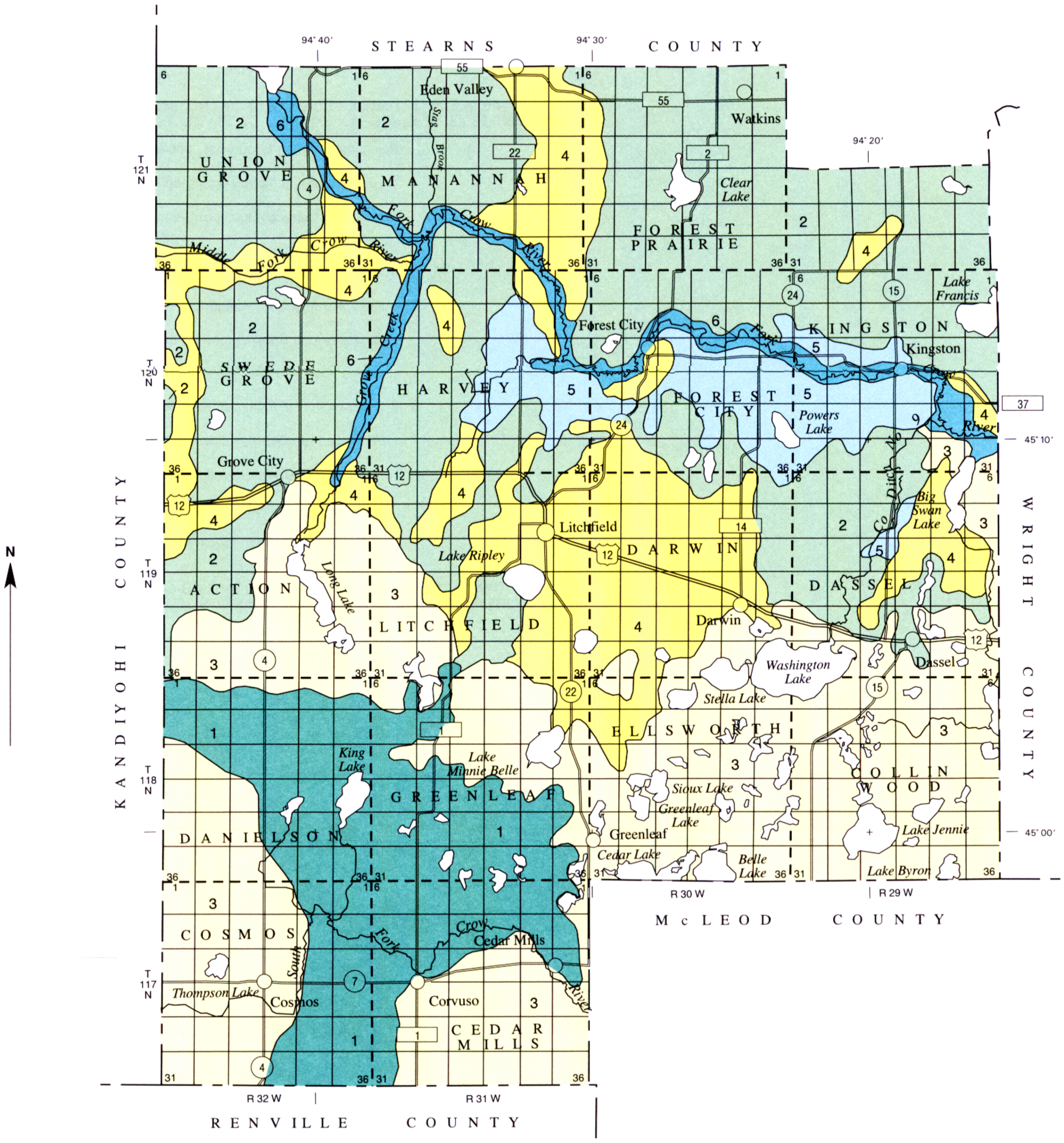
KILOMETERS

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.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STEARNS COUNTY
94° 40′
94° 30′
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KANDIYOHI COUNTY
WRIGHT COUNTY
McLEOD COUNTY
RENVILLE COUNTY
T 121 N
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R 30 W
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UNION GROVE
MANANNAH
FOREST PRAIRIE
SWEDE GROVE
HARVEY
FOREST CITY
KINGSTON
ACTON
LITCHFIELD
DARWIN
DASSEL
DANIELSON
GREENLEAF
ELLSWORTH
COLLINWOOD
COSMOS
CEDAR MILLS
Eden Valley
Watkins
Clear Lake
Lake Francis
Forest City
Kingston
Powers Lake
Grove City
Litchfield
Lake Ripley
Long Lake
Darwin
Washington Lake
Stella Lake
Dassel
Big Swan Lake
King Lake
Lake Minnie Belle
Sioux Lake
Greenleaf Lake
Greenleaf
Cedar Lake
Belle Lake
Lake Jennie
Lake Byron
Cedar Mills
Corvuso
Cosmos
Thompson Lake
Middle Fork Crow River
North Fork Crow River
South Fork Crow River
Crow River
Stag Brook
Grove Creek
Co. Ditch No. 9
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SURFACE LEGEND

1	Kandiyohi Glacial Till
2	Wadena Glacial Till
3	New Ulm Glacial Till
4	New Ulm Outwash
5	Glaciolacustrine Deposits
6	Recent Alluvium

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
MINNESOTA AGRICULTURAL EXPERIMENT STATION

SURFACE GEOLOGY MAP

MEEKER COUNTY, MINNESOTA

Scale 1:253440

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MILES

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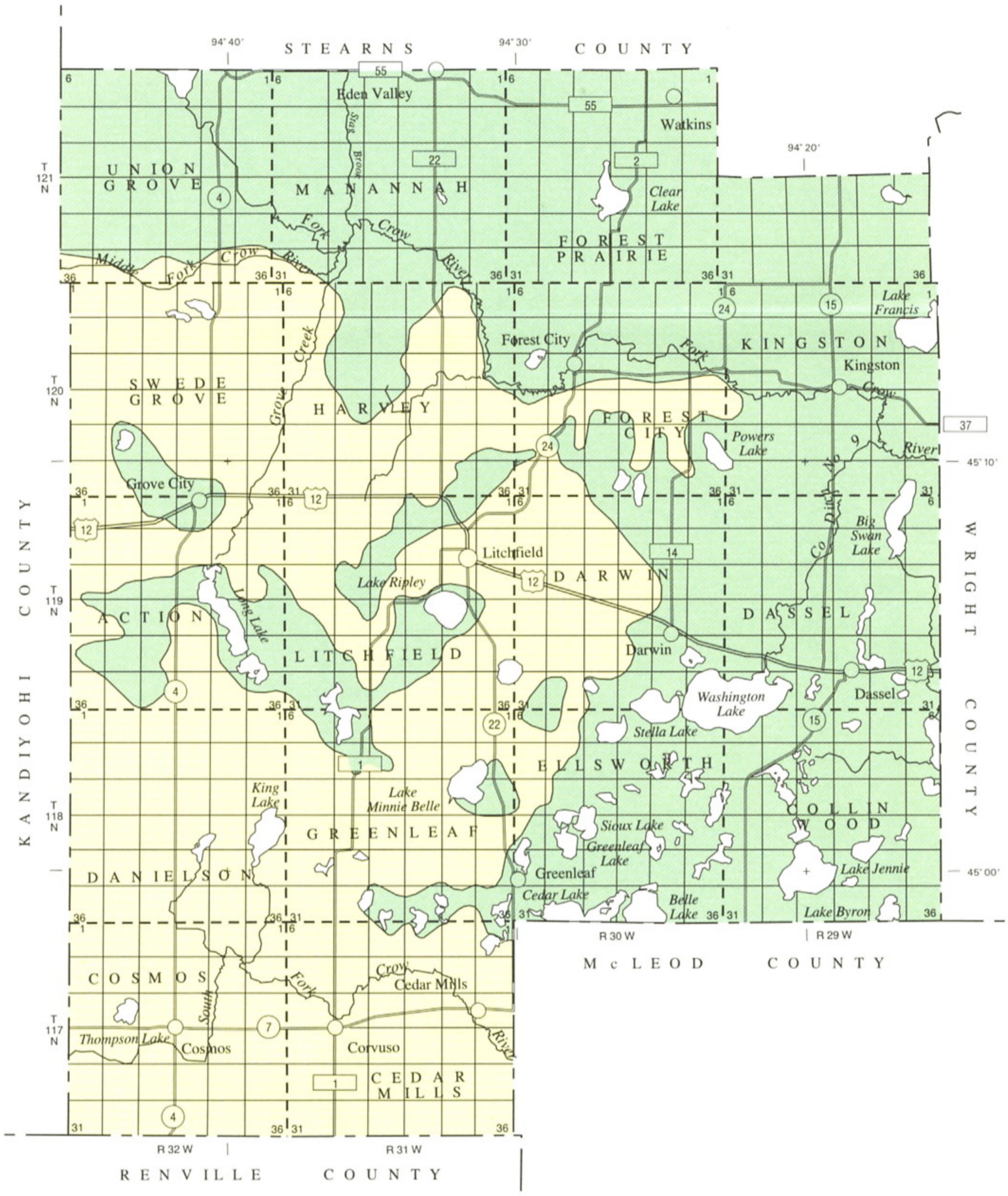
STEARNS COUNTY
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Big Swan Lake
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Grove Creek
Litchfield
Lake Ripley
DARWIN
DASSEL
ACTION
Long Lake
LITCHFIELD
Darwin
Washington Lake
Dassel
Stella Lake
ELLSWORTH
COLLINWOOD
King Lake
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GREENLEAF
Sioux Lake
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CEDAR MILLS
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KANDIYOHI COUNTY
WRIGHT COUNTY
McLEOD COUNTY
RENVILLE COUNTY
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ORIGINAL VEGETATION

🟩 BIGWOODS

🟨 PRAIRIE

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
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UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
MINNESOTA AGRICULTURAL EXPERIMENT STATION

ORIGINAL VEGETATION MAP

MEEKER COUNTY, MINNESOTA

Scale 1:253440

1 0 1 2 3

MILES

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KILOMETERS

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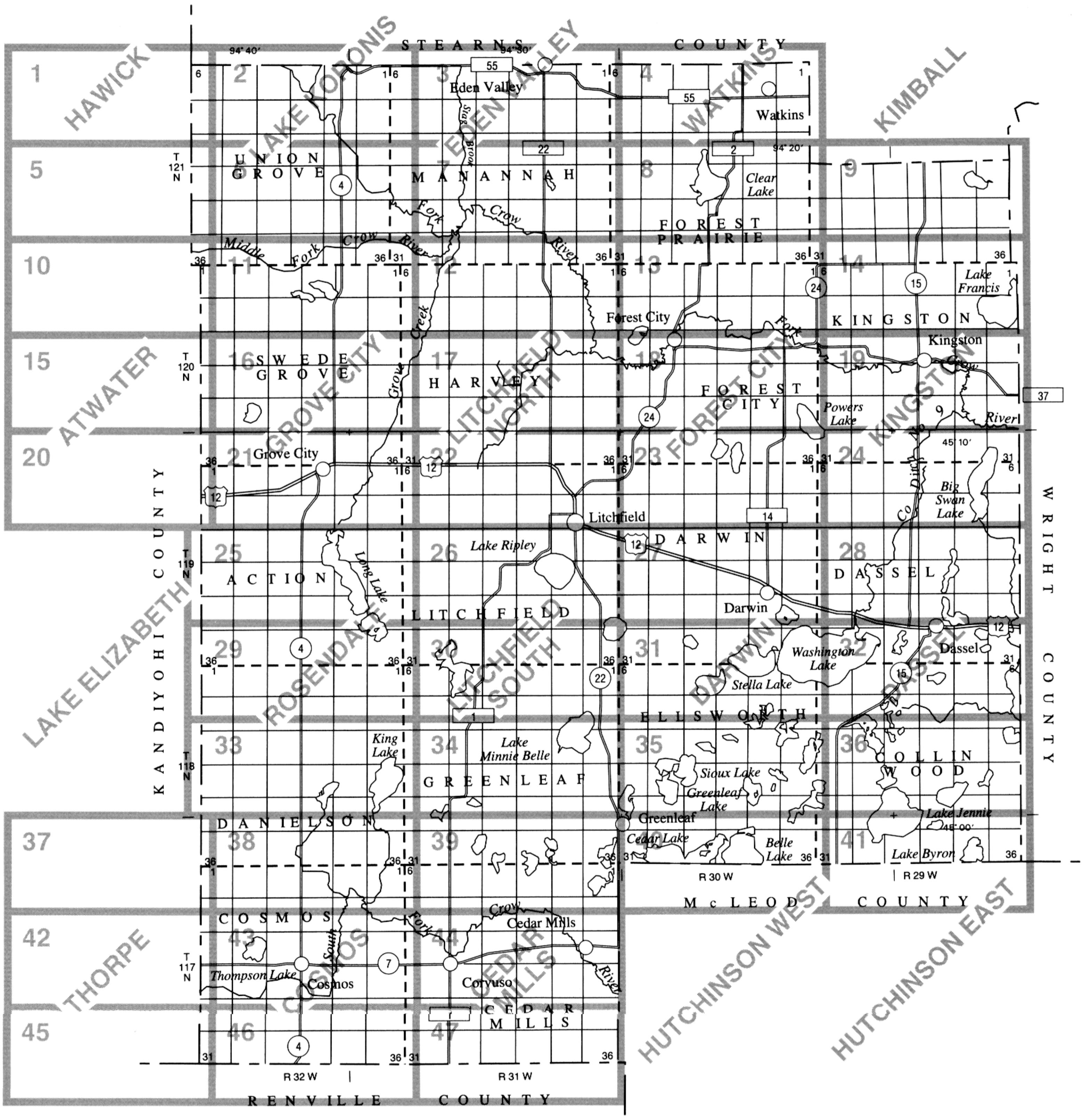
N
STEARNS COUNTY
WRIGHT COUNTY
KANDIYOHI COUNTY
McLEOD COUNTY
RENVILLE COUNTY
1 HAWICK
2 LAKE KORONIS
3 EDEN VALLEY
4 WATKINS
KIMBALL
5
7
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11
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13
14
15 ATWATER
16 GROVE CITY
17 LITCHFIELD NORTH
18 FOREST CITY
19 KINGSTON
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25 LAKE ELIZABETH
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27
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29 ROSENDALE
30 LITCHFIELD SOUTH
31 DARWIN
32 DASSEL
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42 THORPE
43 COSMOS
44 CEDAR MILLS
45
46
47
HUTCHINSON WEST
HUTCHINSON EAST
UNION GROVE
MANANNAH
FOREST PRAIRIE
KINGSTON
SWEDE GROVE
HARVEY
FOREST CITY
ACTON
LITCHFIELD
DARWIN
DASSEL
ELLSWORTH
GREENLEAF
COLLINWOOD
DANIELSON
COSMOS
CEDAR MILLS
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Crow River
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Co. Ditch No. 9
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T 120 N
T 119 N
T 118 N
T 117 N
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R 31 W
R 30 W
R 29 W
94° 40′
94° 30′
94° 20′
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SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS

MEEKER COUNTY, MINNESOTA

Scale 1:253440

1 0 1 2 3

MILES

1 0 1 2 3 4 5 6

KILOMETERS

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following these numbers represents the class of slope. Symbols without a slope letter are for nearly level soils or for miscellaneous areas. A final number of 2 indicates that the soil is moderately eroded. Map units 1171C, 1171D, 1177C, 1213C, and 1220C are moderately eroded but do not have a final number of 2 because of database limitations.

SYMBOL	NAME
8B	Sparta loamy sand, 1 to 6 percent slopes
8C	Sparta loamy sand, 6 to 12 percent slopes
8D	Sparta loamy sand, 12 to 25 percent slopes
35	Blue Earth mucky silt loam, 0 to 1 percent slopes
39A	Wadena loam, 0 to 2 percent slopes
41A	Estherville sandy loam, 0 to 2 percent slopes
85	Calco silty clay loam, 0 to 2 percent slopes, occasionally flooded
86	Canisteo clay loam, moderately fine substratum, 0 to 2 percent slopes
96B	Collinwood silty clay loam, 3 to 6 percent slopes
101B	Truman silt loam, 2 to 6 percent slopes
102B	Clarion loam, moderately fine substratum, 2 to 5 percent slopes
106C2	Lester loam, 6 to 12 percent slopes, eroded
112	Harps clay loam, 0 to 2 percent slopes
113	Webster clay loam, 0 to 2 percent slopes
114	Glencoe clay loam, depressional, 0 to 1 percent slopes
129	Cylinder loam, 0 to 1 percent slopes
130	Nicollet clay loam, 1 to 3 percent slopes
134	Okoboji silty clay loam, depressional, 0 to 1 percent slopes
136	Madelia silty clay loam, 0 to 2 percent slopes
140	Spicer silty clay loam, 0 to 2 percent slopes
143B	Chelsea loamy fine sand, 1 to 6 percent slopes
178	Granby fine sandy loam, 0 to 1 percent slopes
181	Litchfield loamy fine sand, 0 to 2 percent slopes
183	Dassel mucky fine sandy loam, depressional, 0 to 1 percent slopes
197	Kingston silty clay loam, 1 to 3 percent slopes
211	Lura silty clay, depressional, 0 to 1 percent slopes
229	Waldorf silty clay loam, 0 to 2 percent slopes
239	Le Sueur clay loam, 1 to 3 percent slopes
281	Darfur loam, 0 to 2 percent slopes
286B	Shorewood silty clay loam, 3 to 6 percent slopes
311C2	Shorewood silty clay, 6 to 12 percent slopes, eroded
327A	Dickman sandy loam, 0 to 2 percent slopes
327B	Dickman sandy loam, 2 to 6 percent slopes
399	Biscay loam, depressional, 0 to 1 percent slopes
415	Kanaranzi loam, 0 to 3 percent slopes
423	Seaforth loam, 1 to 3 percent slopes
461B	Koronis loam, 2 to 6 percent slopes
461C2	Koronis loam, 6 to 12 percent slopes, eroded
511	Marcellon loam, 0 to 3 percent slopes
523	Houghton muck, depressional, 0 to 1 percent slopes
525	Muskego muck, depressional, 0 to 1 percent slopes
539	Klossner muck, depressional, 0 to 1 percent slopes
548	Medo muck, depressional, 0 to 1 percent slopes
610	Calco silty clay loam, 0 to 1 percent slopes, frequently flooded
611D	Hawick gravelly sandy loam, 12 to 25 percent slopes
612B	Wadenill loam, 2 to 6 percent slopes
613	Grovecity loam, 1 to 3 percent slopes
664	Zook silty clay loam, 0 to 2 percent slopes, occasionally flooded
740	Hamel-Glencoe, depressional, complex, 0 to 3 percent slopes
804B	Koronis-Sunburg-Hawick complex, 2 to 6 percent slopes
804C2	Koronis-Sunburg-Hawick complex, 6 to 12 percent slopes, eroded
804D2	Koronis-Sunburg-Hawick complex, 12 to 18 percent slopes, eroded
804E	Koronis-Sunburg-Hawick complex, 18 to 40 percent slopes
805C2	Sunburg-Wadenill complex, 6 to 12 percent slopes, eroded
805D2	Sunburg-Wadenill complex, 12 to 18 percent slopes, eroded
807D2	Koronis-Sunburg complex, 12 to 18 percent slopes, eroded
875B	Estherville-Hawick complex, 2 to 6 percent slopes
875C	Hawick-Estherville complex, 6 to 12 percent slopes
887B	Clarion-Swanlake complex, 2 to 6 percent slopes
899	Harps-Okoboji, depressional, complex, 0 to 2 percent slopes
909C2	Bold-Truman complex, 6 to 12 percent slopes, eroded
909D2	Bold-Truman complex, 12 to 18 percent slopes, eroded
920B	Clarion-Storden-Hawick complex, 2 to 6 percent slopes
945D2	Lester-Storden complex, 12 to 18 percent slopes, eroded
945E	Lester-Storden complex, 18 to 40 percent slopes
956	Canisteo-Glencoe, depressional, complex, 0 to 2 percent slopes
960C2	Storden-Omsrud complex, 6 to 12 percent slopes, eroded
960D2	Storden-Omsrud complex, 12 to 18 percent slopes, eroded
978	Cordova-Rolfe, depressional, complex, 0 to 2 percent slopes
1015	Udipsamments (cut and fill land)
1016	Udorthents, loamy (cut and fill land)
1030	Pits, gravel-Udipsamments complex
1080	Klossner, Okoboji, and Glencoe soils, 0 to 1 percent slopes
1096	Fieldon-Dassel, depressional, complex, 0 to 2 percent slopes
1097	Mayer-Biscay, depressional, complex, 0 to 2 percent slopes
1098	Biscay-Biscay, depressional, complex, 0 to 2 percent slopes
1099	Granby loamy fine sand, very wet, 0 to 1 percent slopes
1100	Nicollet silty clay loam, 1 to 3 percent slopes
1101	Webster silty clay loam, moderately fine substratum, 0 to 2 percent slopes
1159B	Strout-Arkton complex, 2 to 6 percent slopes
1161	Barry loam, 0 to 2 percent slopes
1162A	Kandiyohi clay, 0 to 2 percent slopes
1162B	Kandiyohi clay, 2 to 5 percent slopes
1163	Cohoctah loam, 0 to 2 percent slopes, frequently flooded
1165	Lundlake silty clay loam, depressional, 0 to 1 percent slopes
1168	Swedegrove-Lundlake, depressional, complex, 0 to 2 percent slopes
1169	Corvuso-Lura, depressional, complex, 0 to 2 percent slopes
1171C	Newlondon-Strout complex, 6 to 12 percent slopes, eroded
1171D	Newlondon-Strout complex, 12 to 18 percent slopes, eroded
1172C	Sparta-Gardencity complex, 6 to 12 percent slopes
1173	Muskego and Klossner soils, depressional, 0 to 1 percent slopes, frequently flooded
1174	Danielson clay loam, 1 to 3 percent slopes
1175	Swedegrove loam, 0 to 2 percent slopes
1176	Litchfield sandy loam, 0 to 2 percent slopes
1177C	Gardencity-Bold complex, 6 to 12 percent slopes, eroded
1178	Uniongrove loam, 0 to 2 percent slopes
1183	Crowriver loam, 0 to 2 percent slopes
1184	Corvuso silty clay loam, 0 to 2 percent slopes
1185	Gardencity fine sandy loam, moderately wet, 0 to 2 percent slopes
1186	Forestcity-Lundlake, depressional, complex, 0 to 3 percent slopes
1192	Crowriver-Lundlake, depressional, complex, 0 to 2 percent slopes
1193	Cosmos silty clay, 0 to 2 percent slopes
1197	Cohoctah fine sandy loam, 0 to 2 percent slopes, occasionally flooded
1198B	Rohrbeck-Koronis complex, 1 to 6 percent slopes
1199	Klossner and Lundlake soils, ponded
1203	Muskego, Blue Earth, and Houghton soils, ponded
1204B	Reedslake loam, 2 to 5 percent slopes
1213C	Cokato-Storden complex, 6 to 12 percent slopes, eroded
1220C	Cokato-Storden-Hawick complex, 6 to 12 percent slopes, eroded
1356	Water, miscellaneous
1362B	Angus loam, 2 to 5 percent slopes
1383A	Shorewood silty clay loam, moderately wet, 0 to 3 percent slopes
1384	Minneopa loam, 0 to 2 percent slopes
1385	Havelock loam, 0 to 2 percent slopes, frequently flooded
1387A	Collinwood silty clay loam, moderately wet, 0 to 3 percent slopes
1391B	Wadenill-Sunburg complex, 2 to 6 percent slopes
1406	Medo, Dassel, and Biscay soils, ponded, 0 to 1 percent slopes
1801B	Gardencity very fine sandy loam, 2 to 6 percent slopes
W	Water

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

County or parish	——— –
Field sheet matchline and neatline	———
STATE COORDINATE TICK 1 890 000 FEET	——┴——
LAND DIVISION CORNER (sections and land grants)	∟ ⊥ + ┼
GEOGRAPHIC COORDINATE TICK	+

ROAD EMBLEMS & DESIGNATIONS

Federal	287
State	(52)

PITS

Gravel pit	⚒

WATER FEATURES

DRAINAGE

Perennial, double line	═══
Perennial, single line	—·—
Intermittent	··—··
Drainage end	⌄→

DRAINAGE AND IRRIGATION

Perennial drainage and/or irrigation ditch	—►———
Intermittent drainage and/or irrigation ditch	—►—···—

MISCELLANEOUS WATER FEATURES

Marsh or swamp	⫫
Wet spot	Ψ

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS	41A ✕ 1015

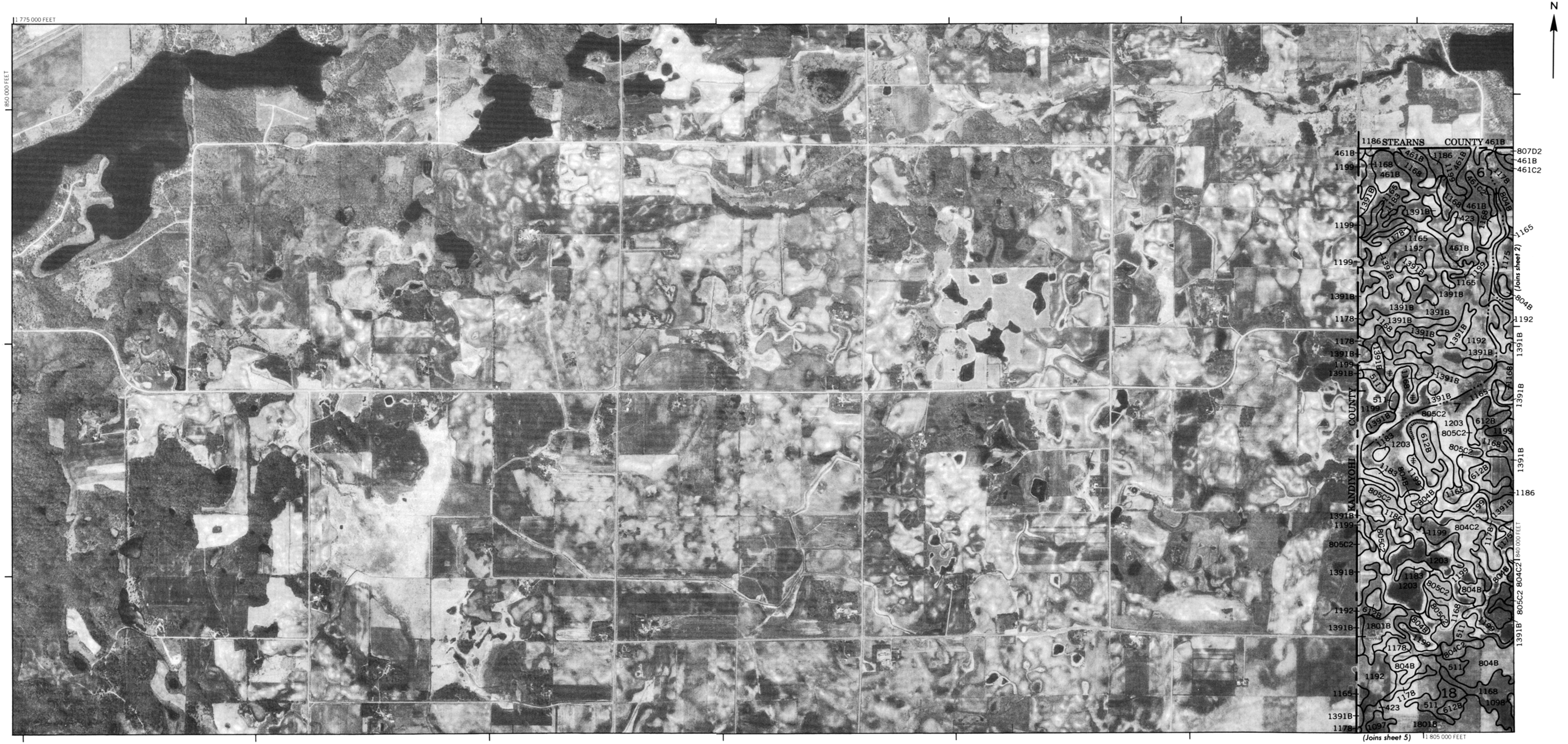
ESCARPMENTS

Other than bedrock (points down slope)	▾▾▾▾▾▾▾▾▾▾▾
SHORT STEEP SLOPE	···········

MISCELLANEOUS

Gravelly spot	∘°∘
Sandy spot	⁘
Very stony spot	ꝏ
Wet depression,restricted permeability	⊕
Organic spot	⌧
Disturbed/Reclaimed Land	✱
Knoll of better drained soil	‡
No access-reduce reliability	No access

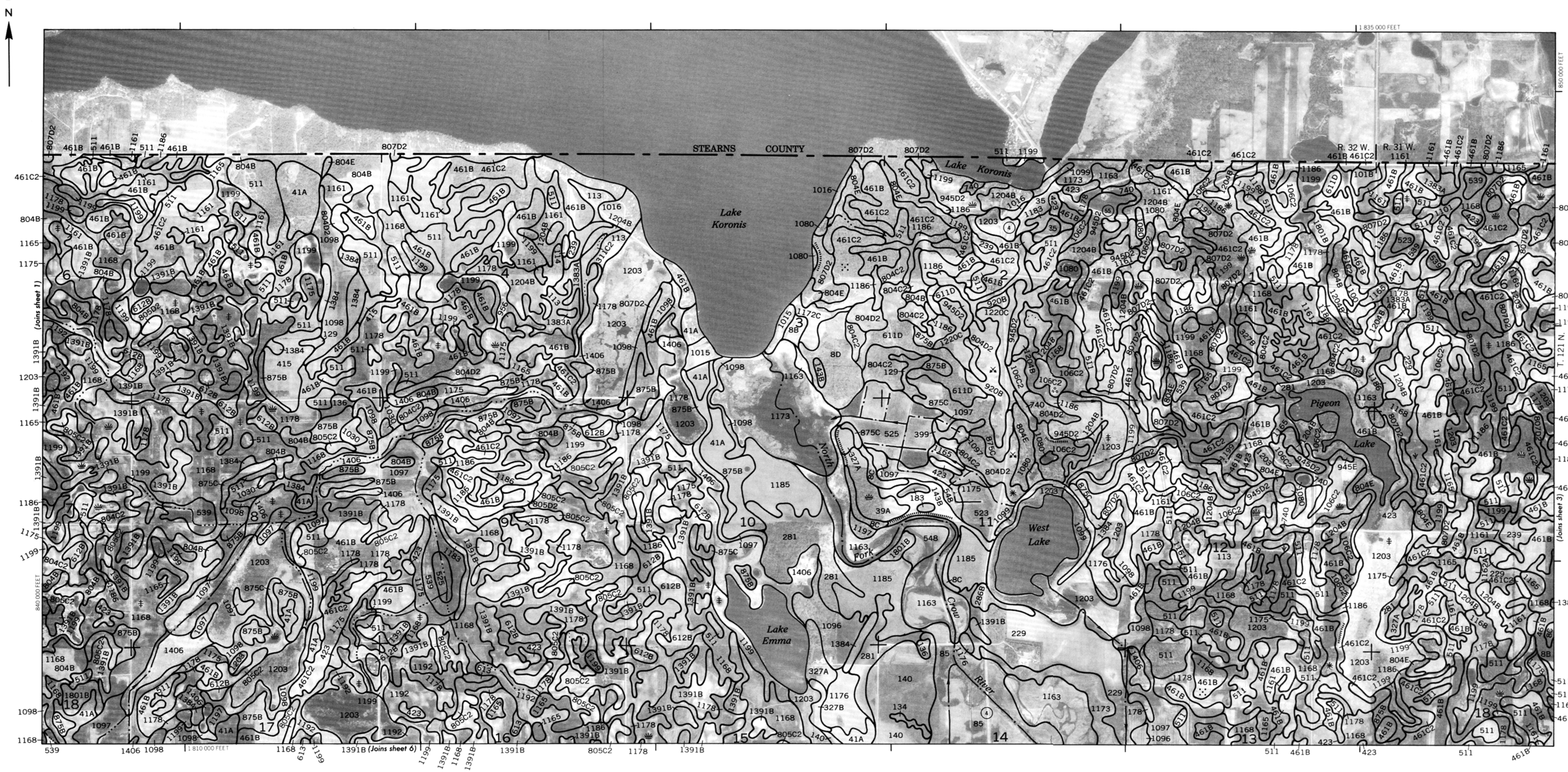
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 1



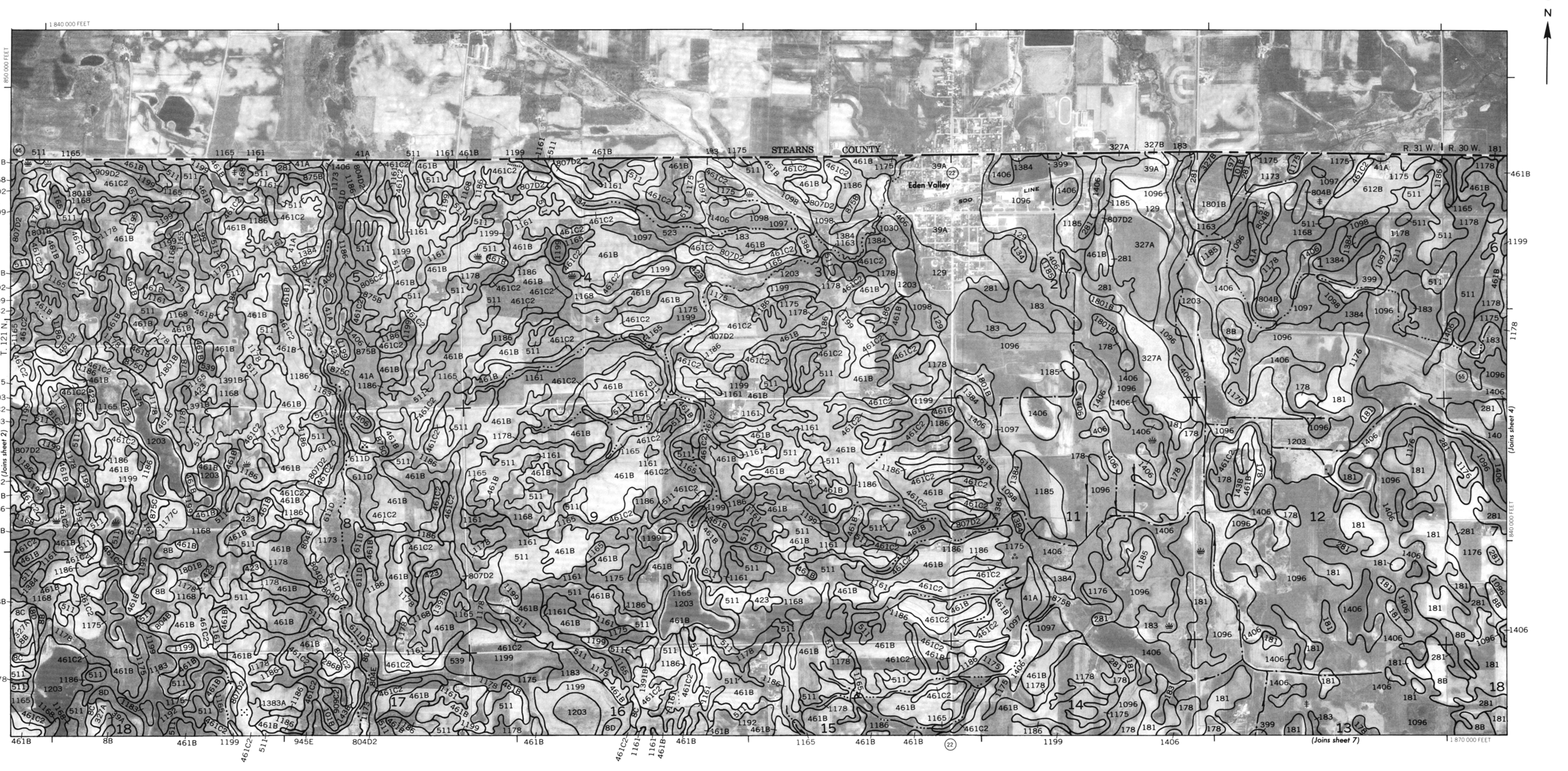
①
N
1 775 000 FEET
850 000 FEET
840 000 FEET
1 805 000 FEET
STEARNS COUNTY
KANDIYOHI COUNTY
(Joins sheet 2)
(Joins sheet 5)
6
7
18
1186
461B
1199
1391B
1178
1192
1165
1168
423
804B
804C2
805C2
807D2
461C2
1175
1183
1203
612B
511
1801B
1097
1098

②

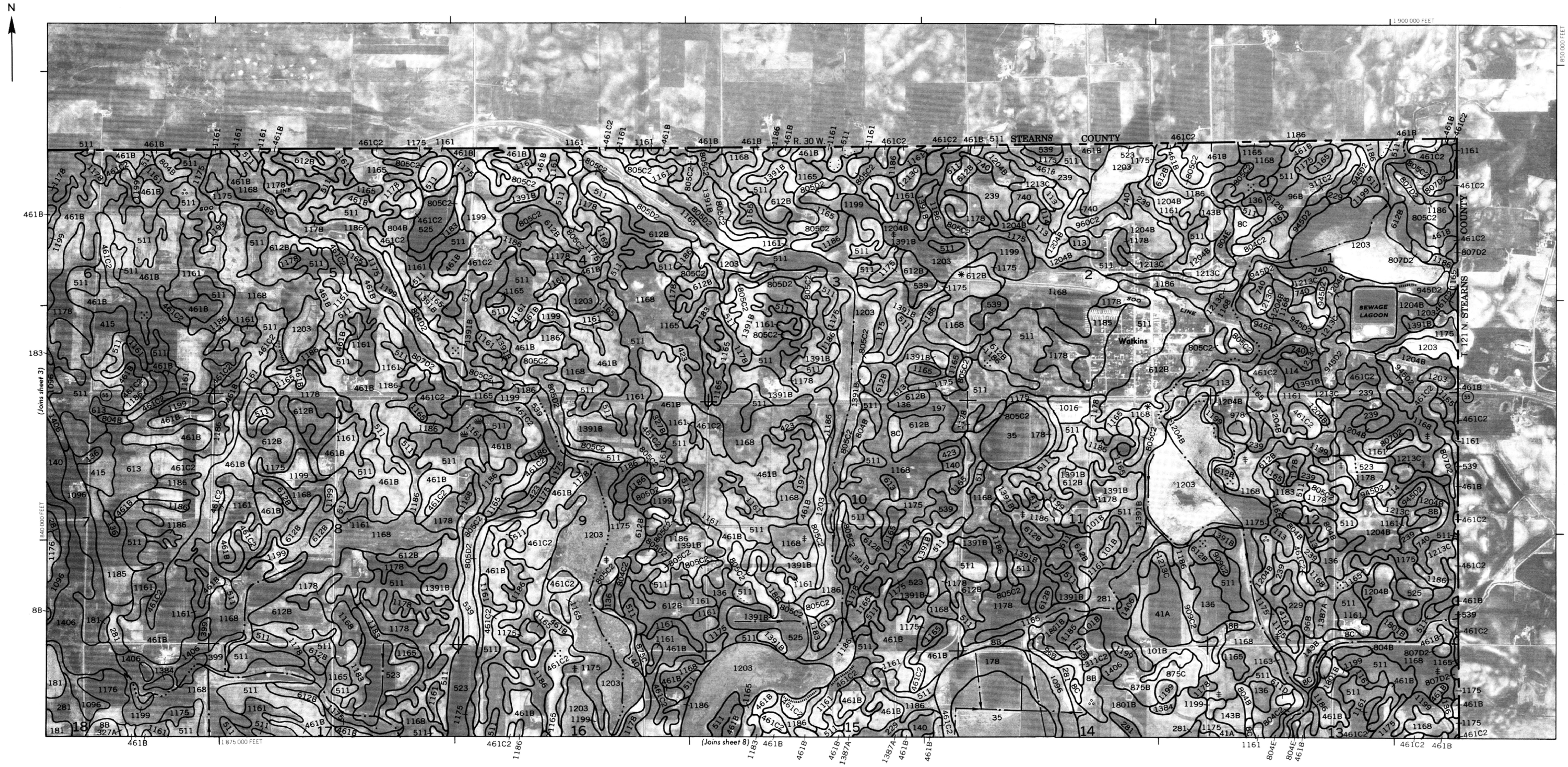
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 2


N
STEARNS COUNTY
Lake Koronis
West Lake
Pigeon Lake
Lake Emma
North Fork Crow River
R. 32 W.
R. 31 W.
T. 121 N.
1 835 000 FEET
850 000 FEET
840 000 FEET
1 810 000 FEET
(Joins sheet 1)
(Joins sheet 3)
(Joins sheet 6)

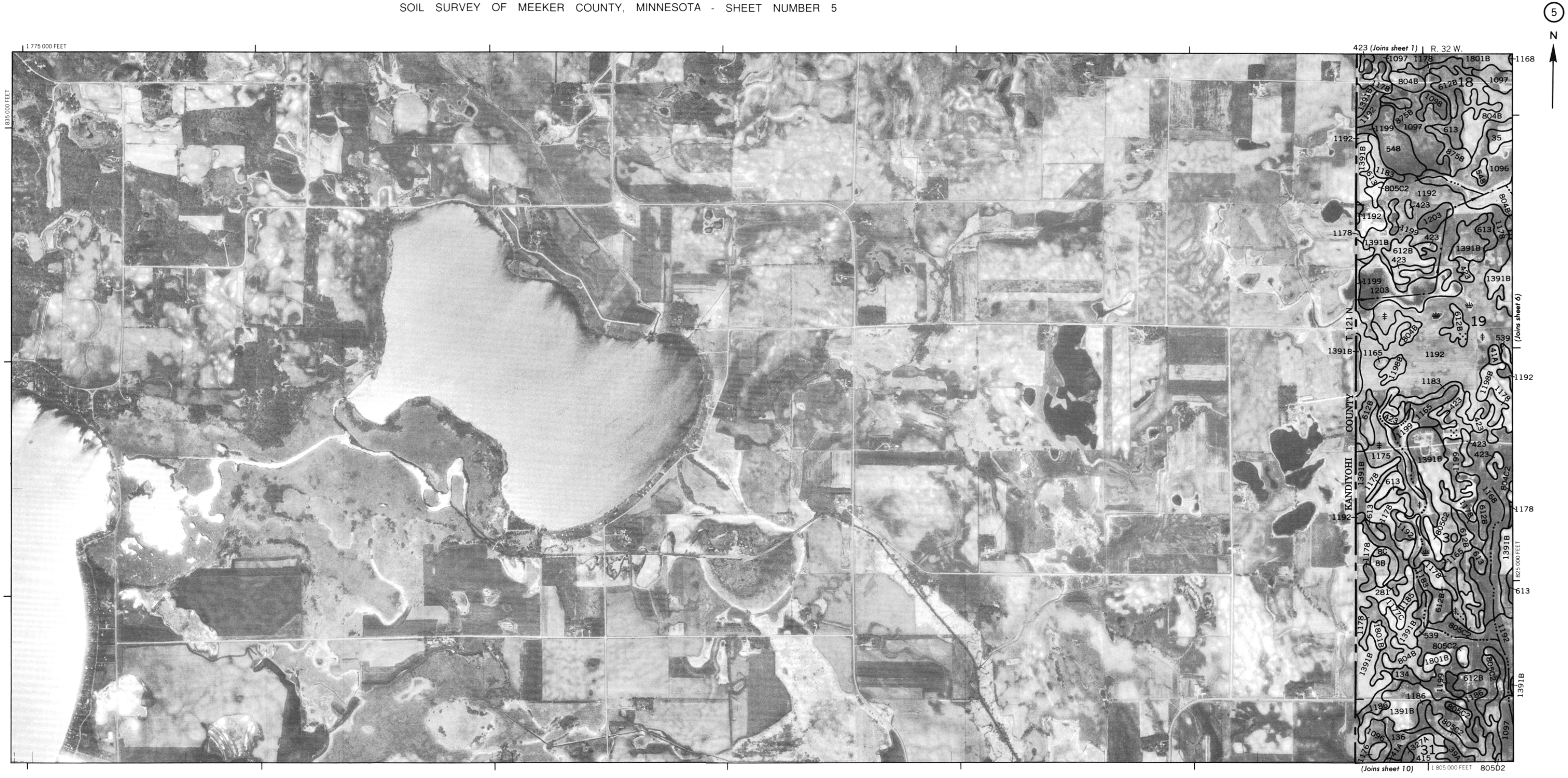
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 3


3
N
1 840 000 FEET
850 000 FEET
STEARNS COUNTY
Eden Valley
LINE
SOO
R. 31 W.
R. 30 W.
T. 121 N.
(Joins sheet 2)
(Joins sheet 4)
(Joins sheet 7)
840 000 FEET
1 870 000 FEET
55
22
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 4

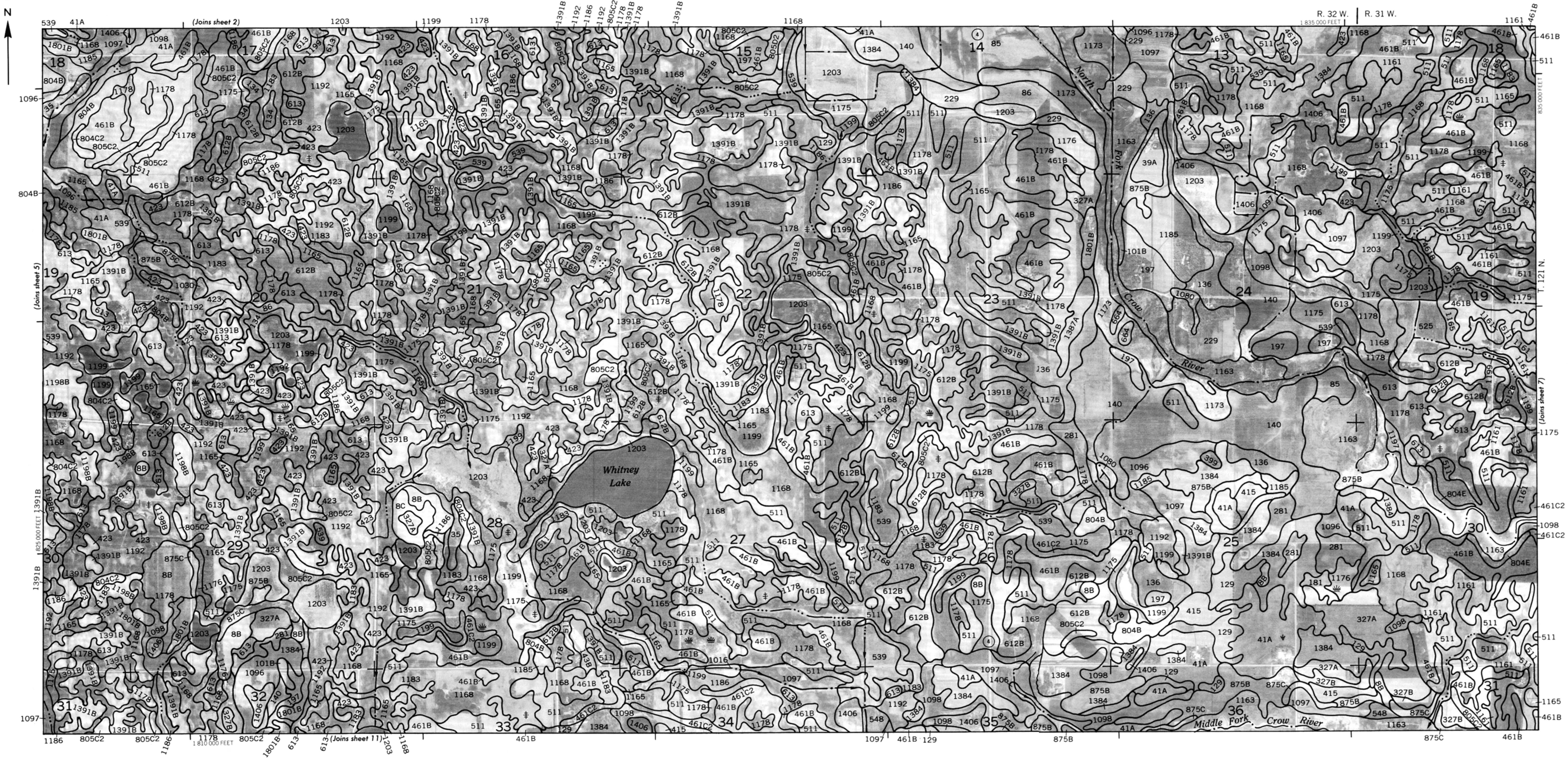

N
STEARNS COUNTY
R. 30 W.
T. 121 N.
STEARNS COUNTY
Watkins
SEWAGE LAGOON
SOO LINE
LINE
(Joins sheet 3)
(Joins sheet 8)
1 900 000 FEET
850 000 FEET
840 000 FEET
1 875 000 FEET
55
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
461B
183
8B
1161
461C2
807D2
1175
539
1183
1186
1387A
804E
41A
511
1199
1203
1168
1178
1165
1391B
612B
805C2
805D2
945D2
1213C
1204B
740
239
113
136
8C
35
178
1016
1406
1096
181
281
1176
1185
613
415
140
523
525
423
197
1801B
875B
875C
101B
143B
229
968
978
114
96B
311C2
804B
804C2
960C2
945E
1384
399
327A
1173

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 5


5
N
1 775 000 FEET
835 000 FEET
423 (Joins sheet 1)
R. 32 W.
1097
1178
1801B
1168
804B
612B
18
1097
1178
1391B
1192
1098
875B
804B
1199
1097
613
1192
35
548
875B
1096
1391B
1183
613
548
805C2
1192
423
804B
1192
1203
1178
1199
613
1178
1391B
423
612B
423
1391B
423
1199
1203
1391B
19
612B
804B
539
T. 121 N.
1391B
1165
1192
41A
(Joins sheet 6)
1198B
1198B
1192
1183
1178
612B
423
1165
423
423
1199
423
1175
1391B
423
KANDIYOHI COUNTY
1391B
1199
804C2
1178
613
1168
1178
1192
613
1178
805C2
612B
1192
612B
30
612B
1391B
825 000 FEET
1178
8C
1165
613
8B
1178
1183
613
281
1185
612B
1177C
1391B
805C2
1178
1801B
539
1192
805C2
1391B
804B
1801B
805C2
1391B
134
1199
612B
1186
1186
1186
1391B
805C2
1096
136
805C2
1097
1176
327A
41A
31
39A
415
(Joins sheet 10)
1 805 000 FEET
805D2

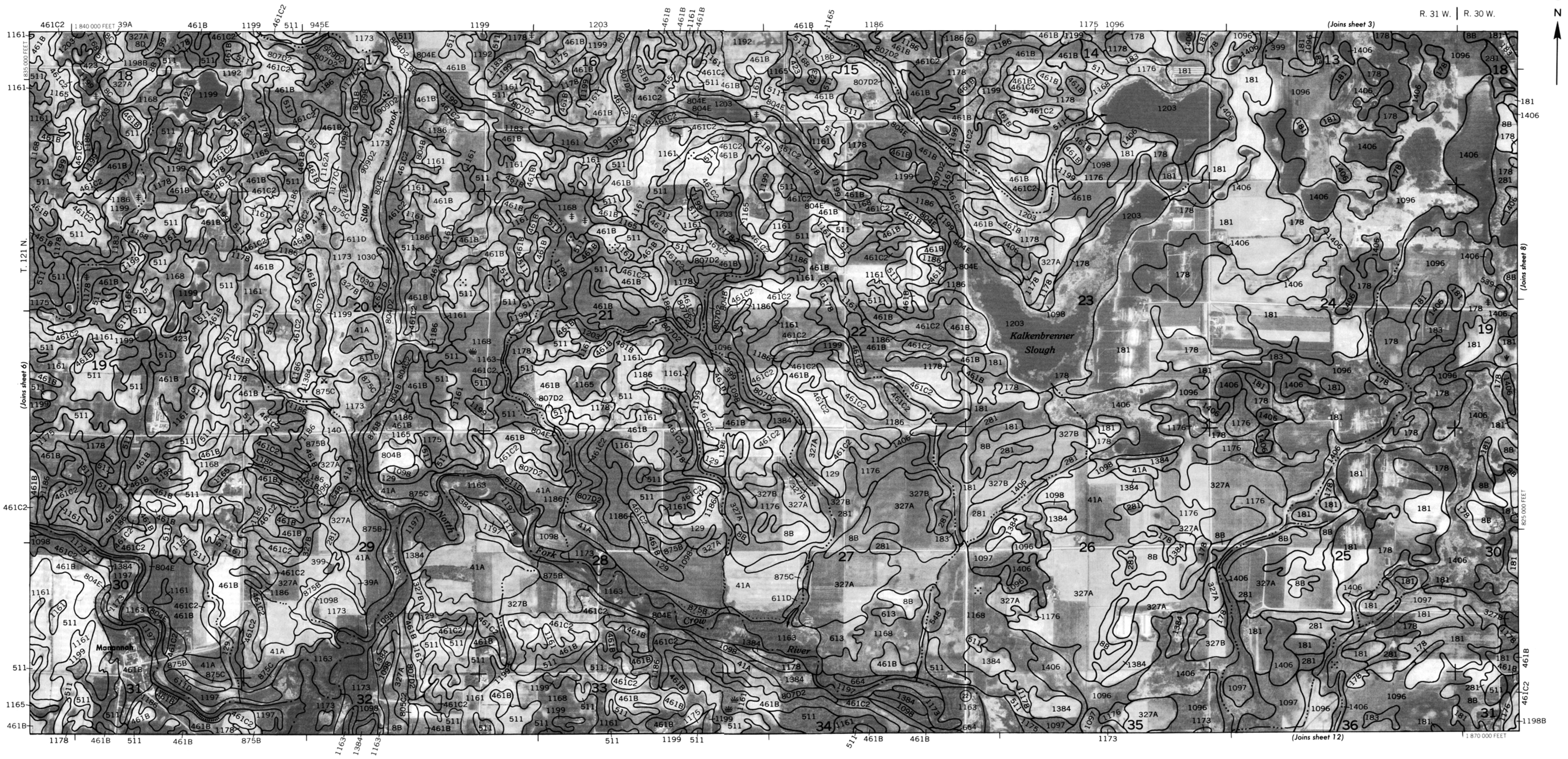
⑥

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 6


N
(Joins sheet 2)
(Joins sheet 5)
(Joins sheet 7)
(Joins sheet 11)
R. 32 W.
R. 31 W.
T. 121 N.
1 835 000 FEET
835 000 FEET
825 000 FEET
1 810 000 FEET
Whitney Lake
North Fork Crow River
Middle Fork Crow River
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36

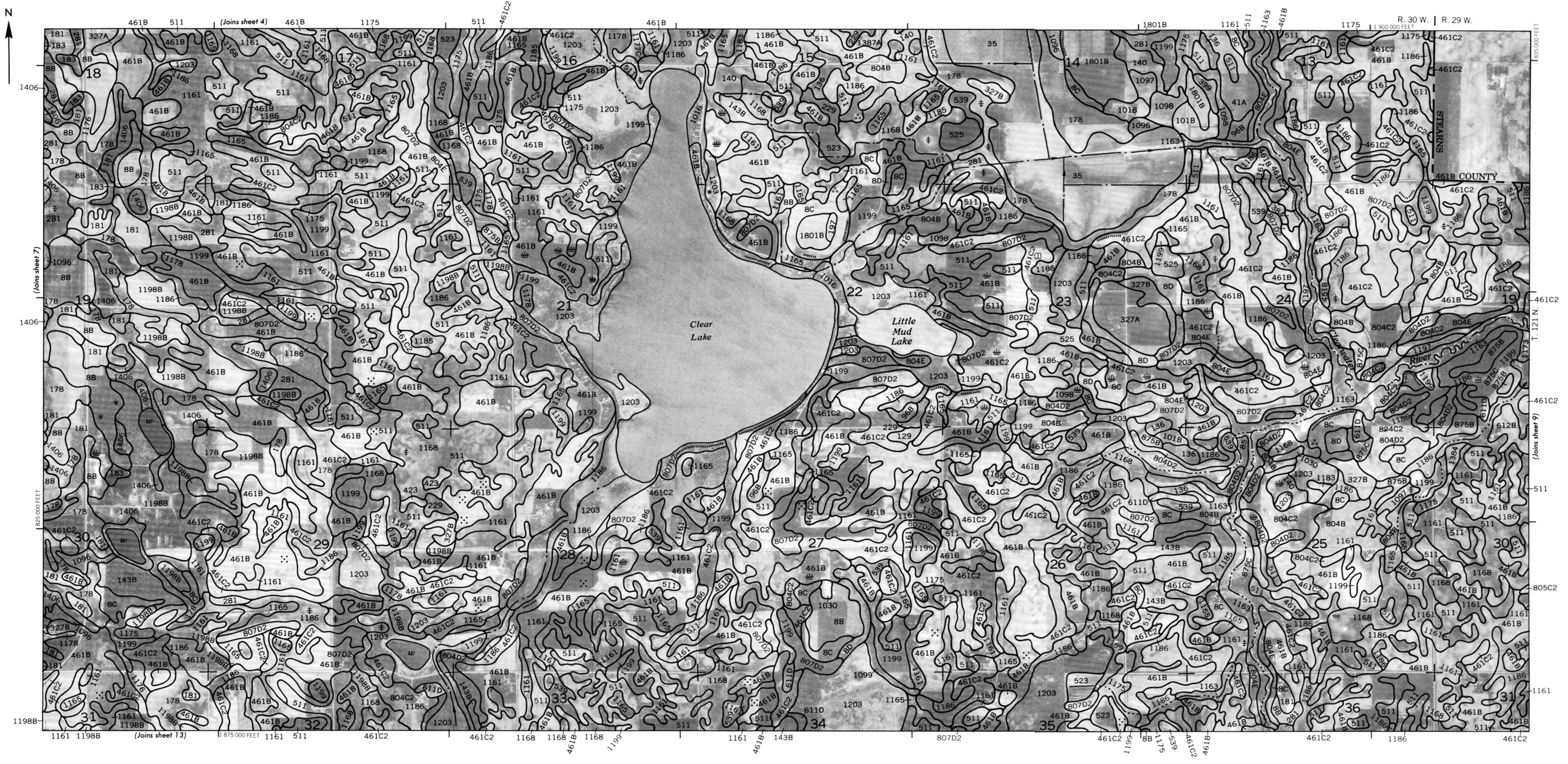
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 7

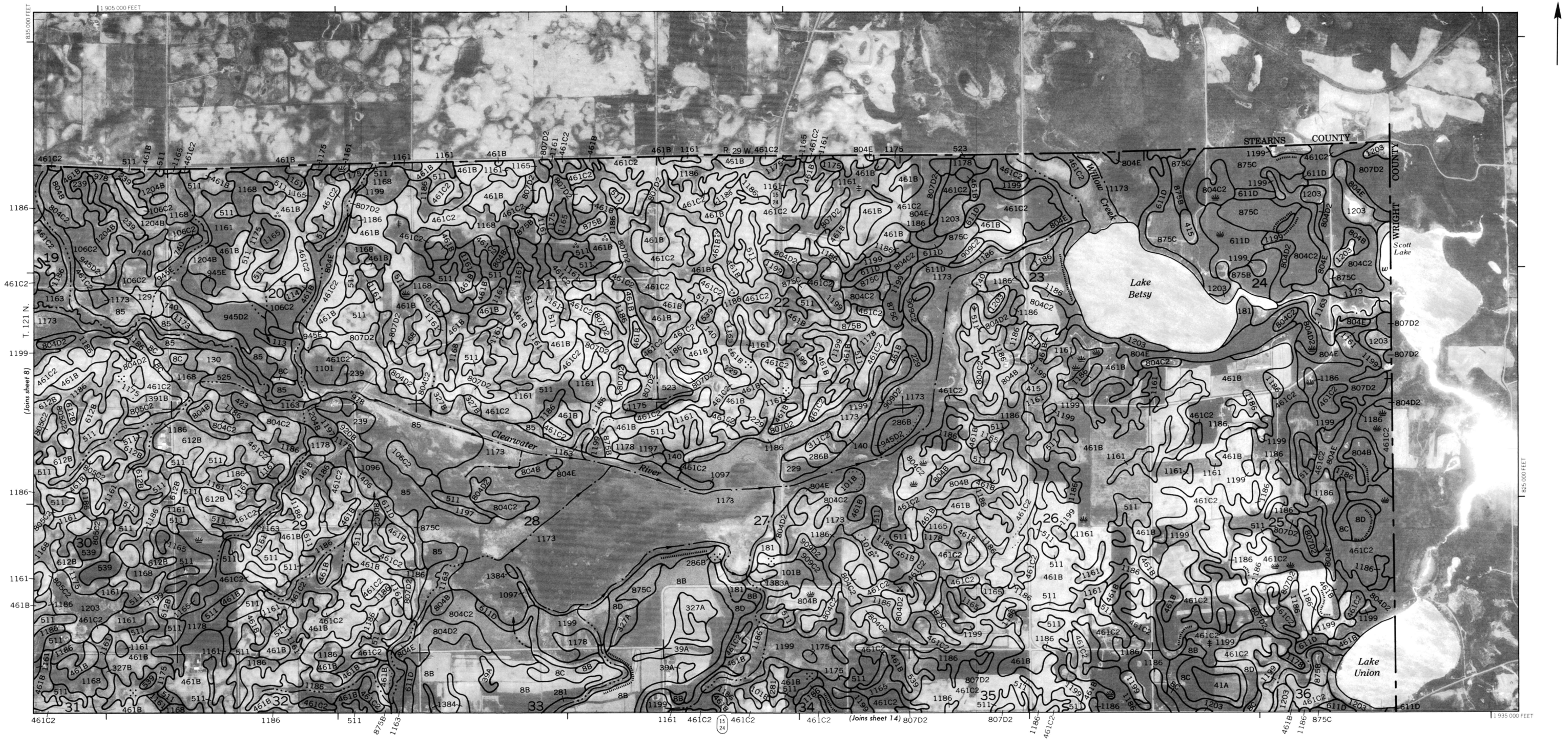
7

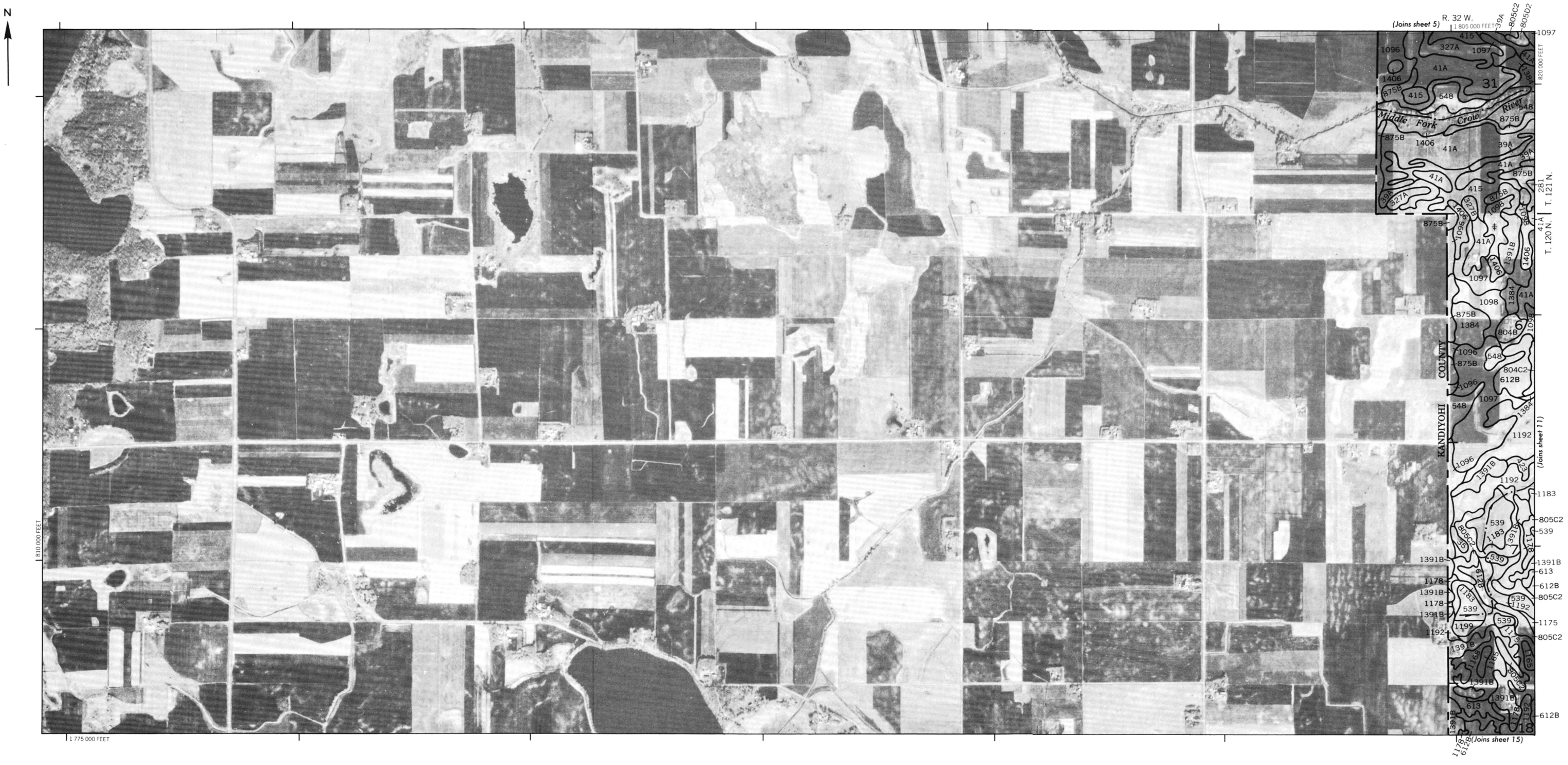

N
R. 31 W.
R. 30 W.
T. 121 N.
(Joins sheet 3)
(Joins sheet 6)
(Joins sheet 8)
(Joins sheet 12)
1 840 000 FEET
1 835 000 FEET
825 000 FEET
1 870 000 FEET
Stag Brook
Kalkenbrenner Slough
North Fork Crow River
Manannah
17
16
15
14
13
18
20
21
22
23
24
19
29
28
27
26
25
30
31
32
33
34
35
36
22

⑧

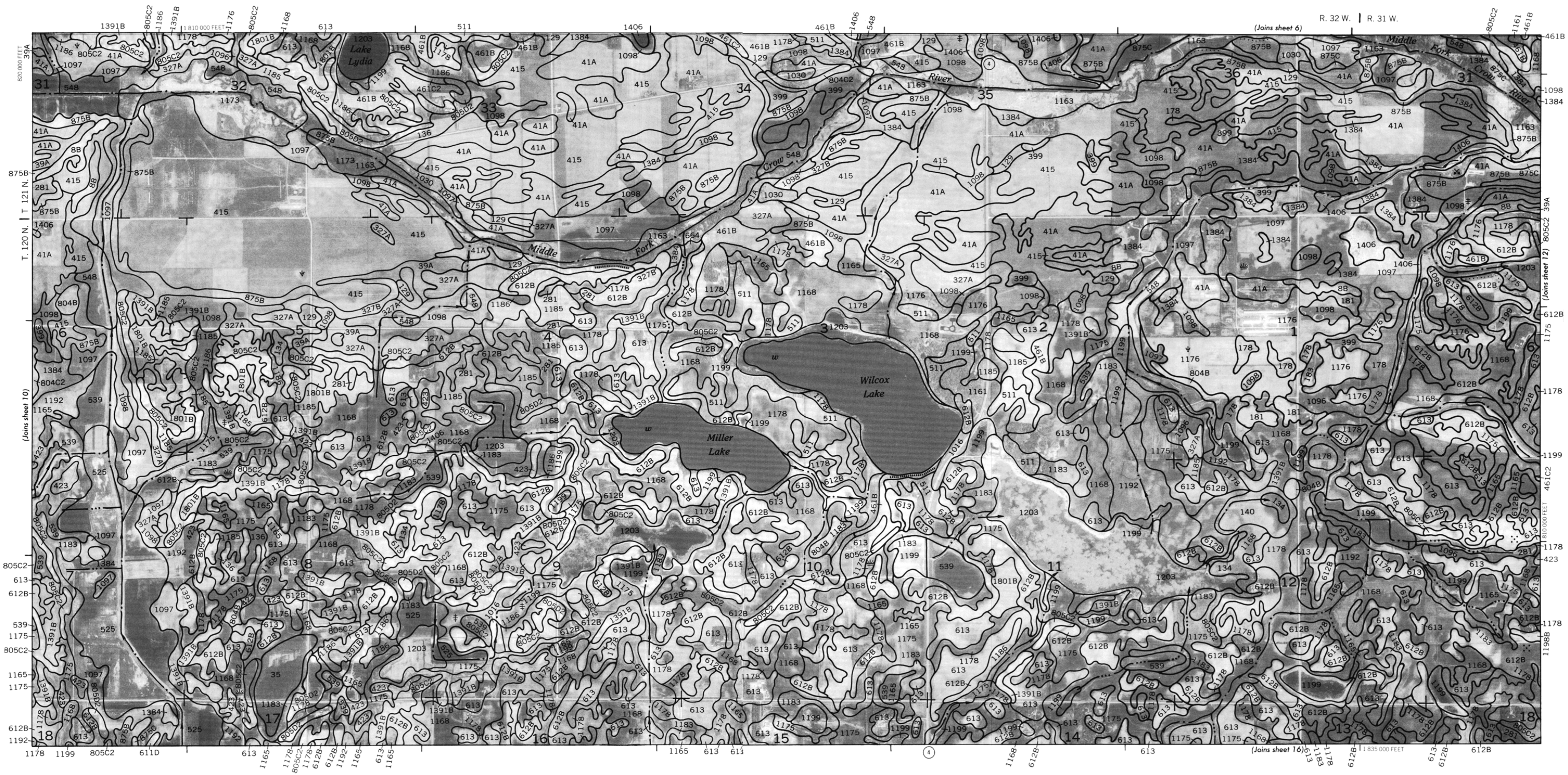
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 8


N
(Joins sheet 4)
(Joins sheet 7)
(Joins sheet 9)
(Joins sheet 13)
R. 30 W.
R. 29 W.
T. 121 N.
1 900 000 FEET
1 875 000 FEET
825 000 FEET
835 000 FEET
STEARNS COUNTY
Clear Lake
Little Mud Lake
Clearwater River
18
17
16
15
14
13
19
20
21
22
23
24
30
29
28
27
26
25
31
32
33
34
35
36


N
1 905 000 FEET
835 000 FEET
STEARNS COUNTY
WRIGHT COUNTY
R. 29 W.
T. 121 N.
(Joins sheet 8)
(Joins sheet 14)
825 000 FEET
1 935 000 FEET
Lake Betsy
Scott Lake
Lake Union
Willow Creek
Clearwater River
15
24
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
1186
461C2
1199
1186
1161
461B
807D2
807D2
804D2
461C2
1186
511
875B
1163
1161
461C2
461C2
461C2
807D2
807D2
1186
461C2
461B
1186
875C


N
(Joins sheet 5)
R. 32 W.
1 805 000 FEET
39A
805C2
805D2
1097
820 000 FEET
1096
415
327A
1097
41A
1406
31
1384
875B
415
548
Middle Fork Crow River
548
875B
875B
1406
41A
39A
39A
41A
875B
41A
415
39A
327A
875B
1098
1406
327B
1098
281
T. 121 N.
T. 120 N.
41A
875B
1096
41A
1391B
1406
1406
1097
1384
41A
1098
875B
1384
804B
6
1098
1096
875B
548
804C2
612B
1096
1097
548
1384
KANDIYOHI COUNTY
1192
(Joins sheet 11)
1096
1391B
423
1192
1183
805C2
539
539
1183
1391B
805C2
35
7
1178
539
1391B
1391B
613
612B
1178
612B
1183
1391B
539
805C2
1192
1178
539
1391B
1199
539
1175
1192
1175
805C2
1391B
1168
1165
1165
805C2
1391B
1391B
613
1178
1192
612B
1391B
18
1178
612B
(Joins sheet 15)
810 000 FEET
1 775 000 FEET

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 11


N
(Joins sheet 6)
(Joins sheet 10)
(Joins sheet 12)
(Joins sheet 16)
R. 32 W.
R. 31 W.
T. 121 N.
T. 120 N.
1 810 000 FEET
820 000 FEET
1 835 000 FEET
Lake Lydia
Wilcox Lake
Miller Lake
Middle Fork Crow River
w
4
31
32
33
34
35
36
6
5
4
3
2
1
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9
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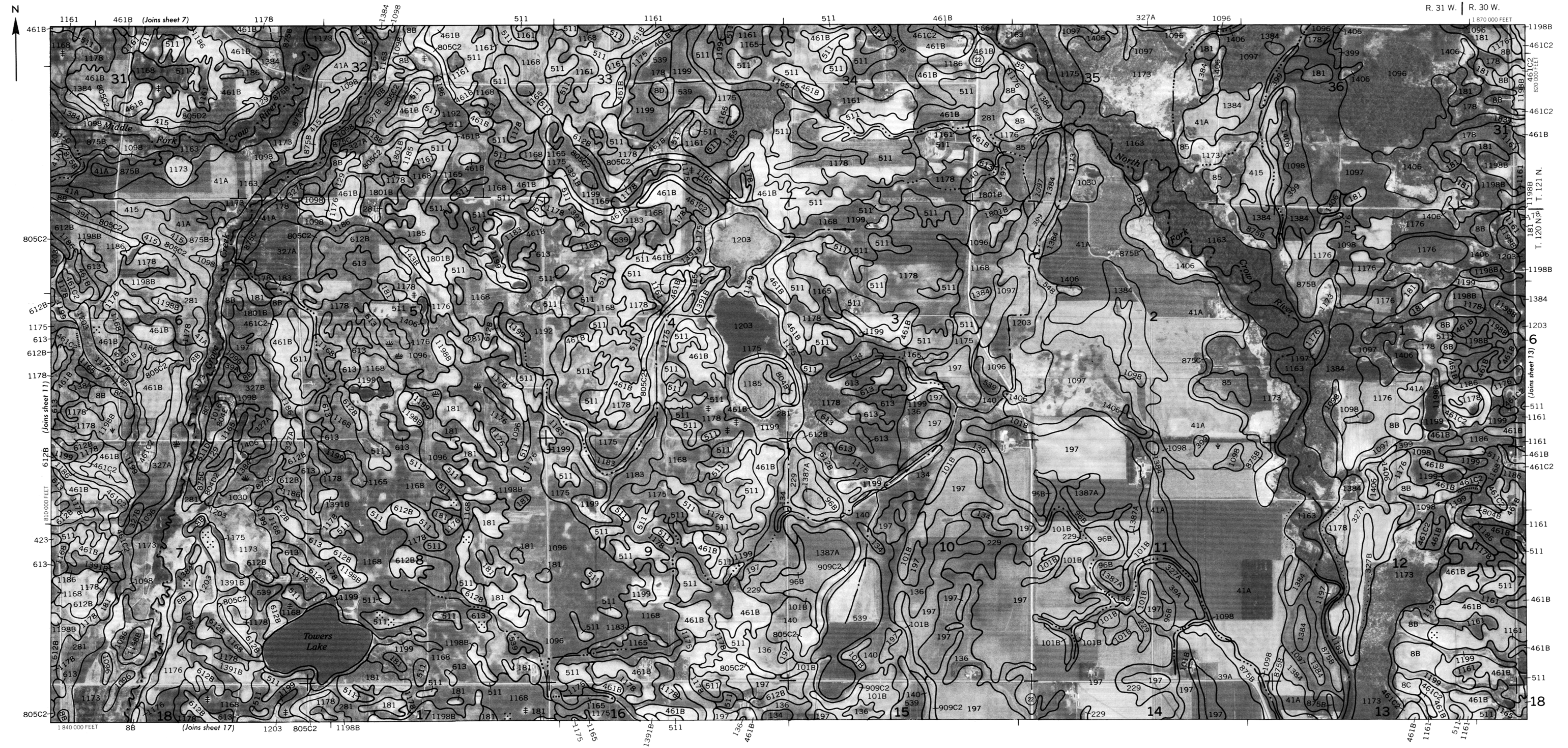
11
12
18
17
16
15
14
13

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 12


N
(Joins sheet 7)
(Joins sheet 11)
(Joins sheet 13)
(Joins sheet 17)
R. 31 W.
R. 30 W.
T. 121 N.
T. 120 N.
1 870 000 FEET
820 000 FEET
810 000 FEET
1 840 000 FEET
Middle Fork Crow River
North Fork Crow River
Crow Creek
Towers Lake
22
31
32
33
34
35
36
31
6
5
4
3
2
1
6
7
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9
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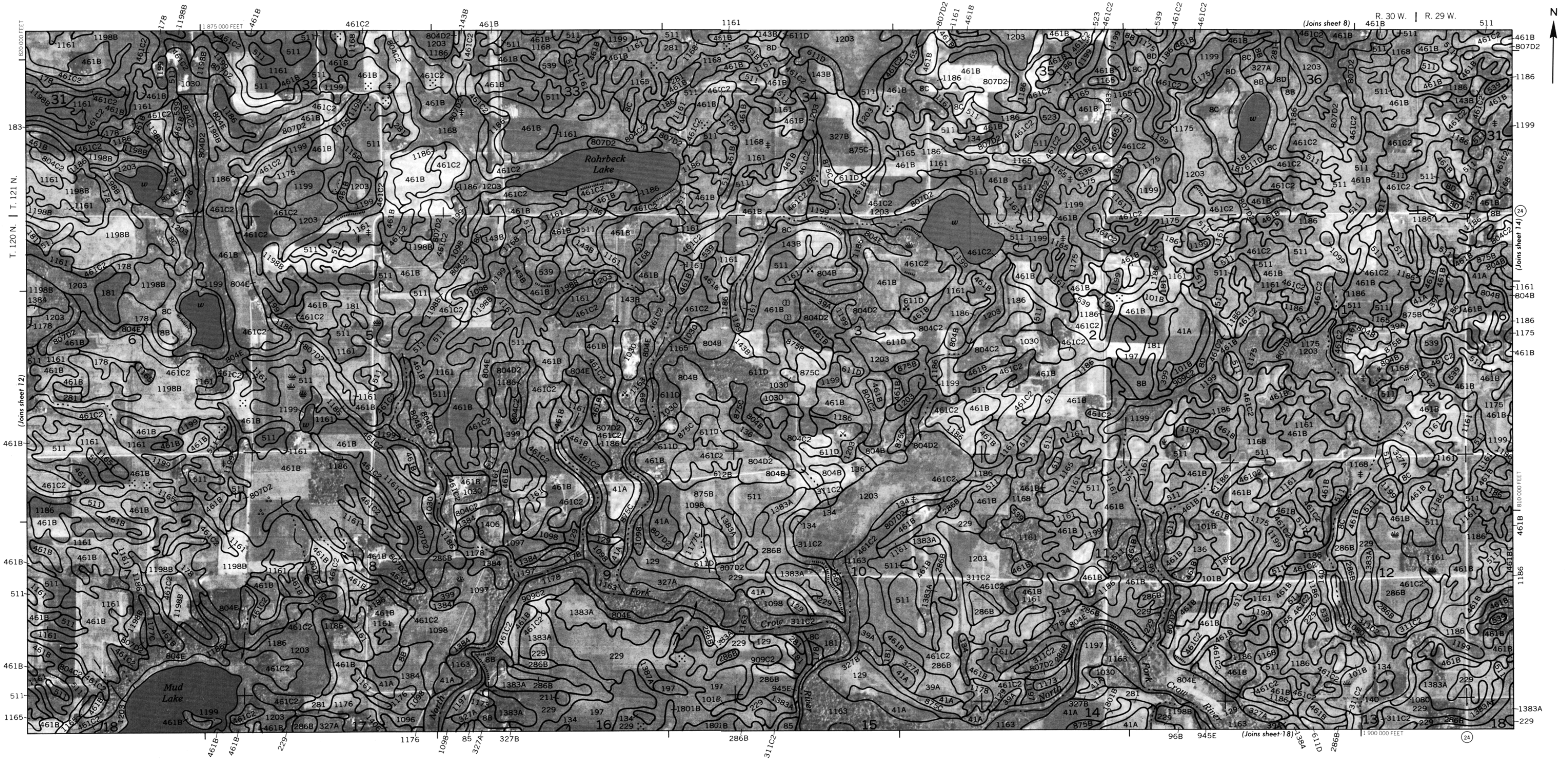
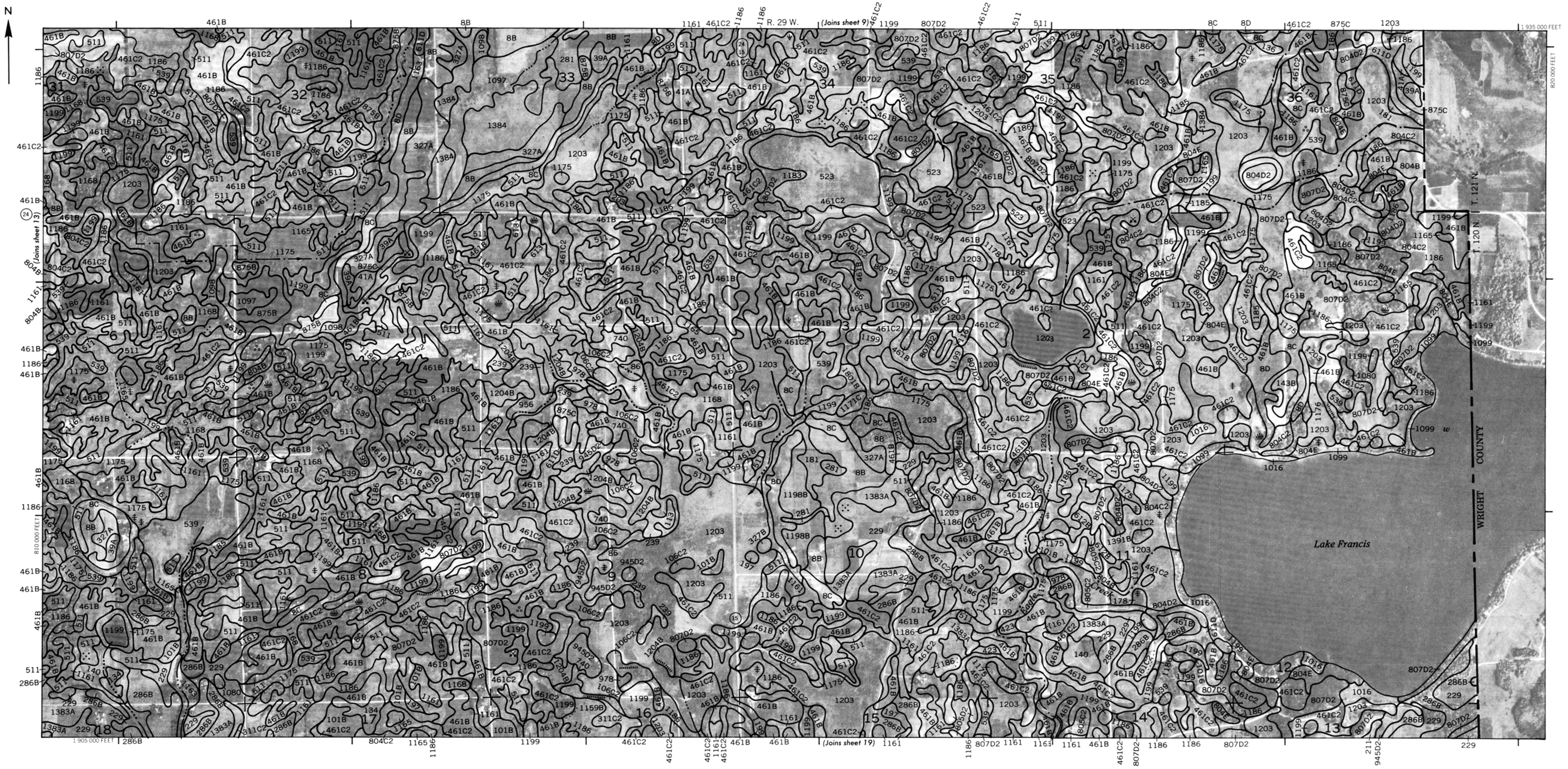
11
12
18
17
16
15
14
13
18

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 13


N
(Joins sheet 8)
(Joins sheet 12)
(Joins sheet 14)
(Joins sheet 18)
R. 30 W.
R. 29 W.
T. 121 N.
T. 120 N.
1 875 000 FEET
1 900 000 FEET
820 000 FEET
810 000 FEET
Rohrbeck Lake
Mud Lake
North Fork Crow River
w
㉔
31
32
33
34
35
36
31
6
5
4
3
2
1
8
9
10
11
12
18
17
16
15
14
13
18


N
R. 29 W.
(Joins sheet 9)
(Joins sheet 13)
(Joins sheet 19)
T. 121 N.
T. 120 N.
WRIGHT COUNTY
Lake Francis
Eagle Creek
1 935 000 FEET
820 000 FEET
810 000 FEET
1 905 000 FEET
31
32
33
34
35
36
6
5
4
3
2
1
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16
15
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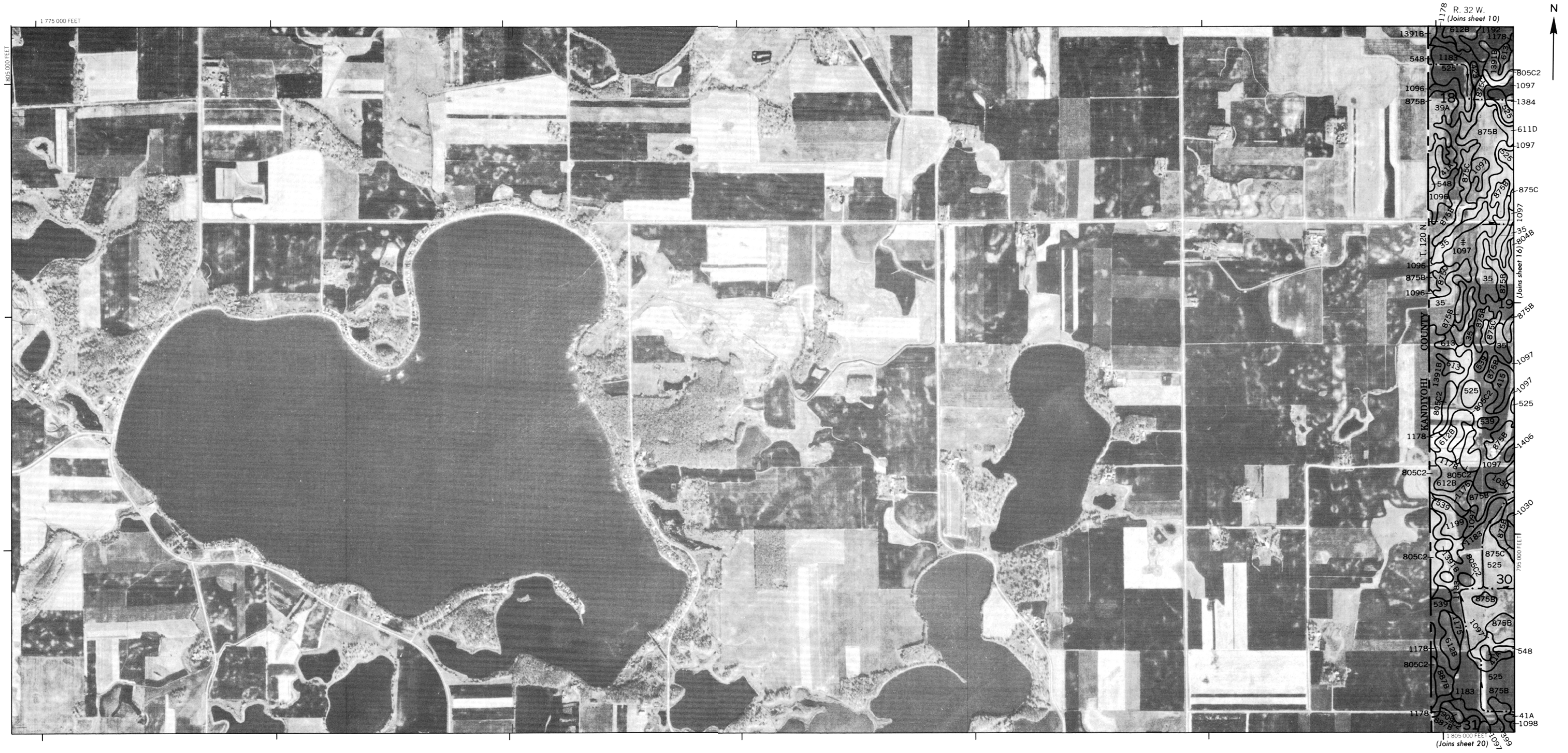
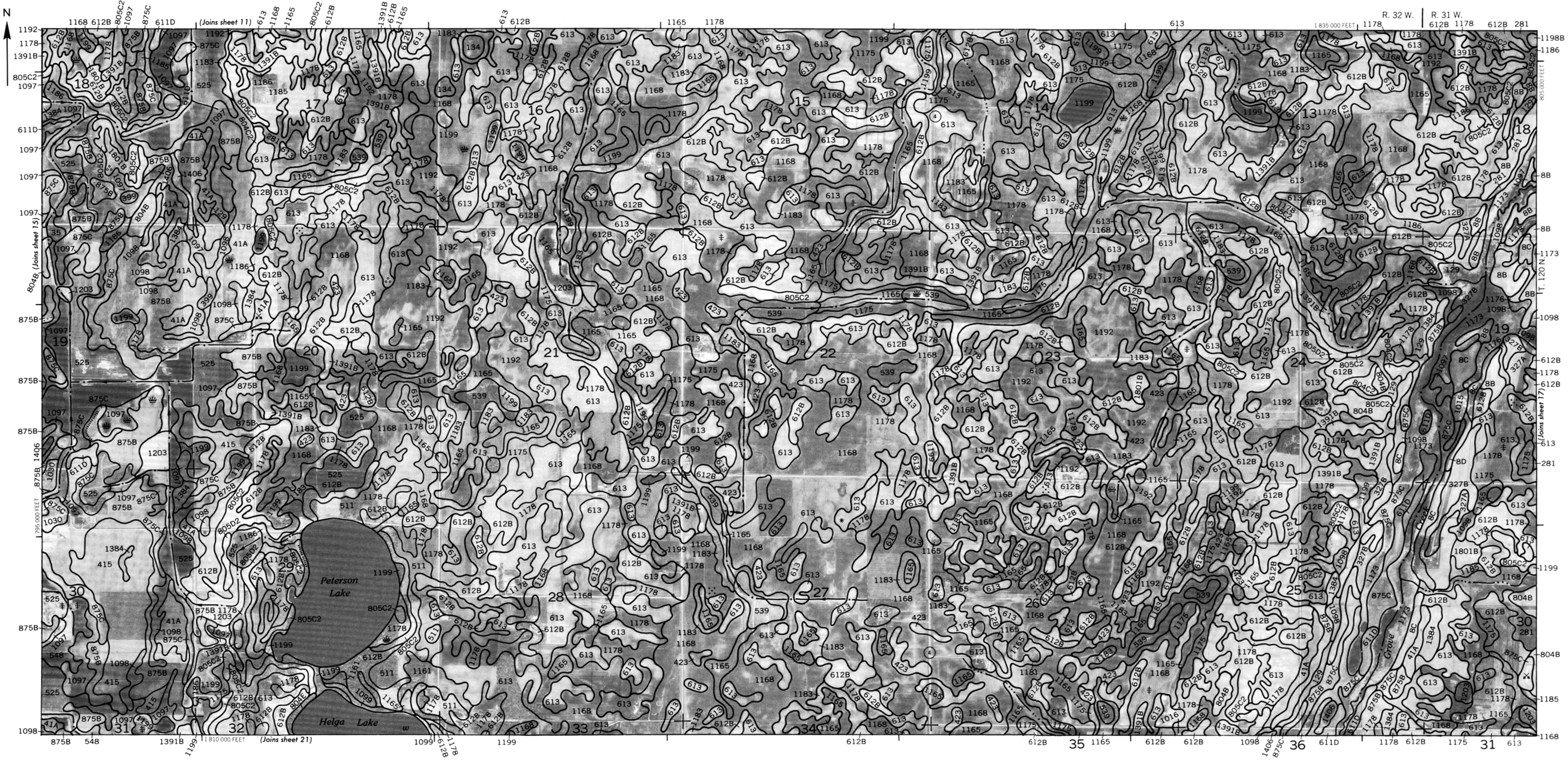
13
24
15

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 15


1 775 000 FEET
805 000 FEET
795 000 FEET
1 805 000 FEET
R. 32 W.
(Joins sheet 10)
(Joins sheet 16)
(Joins sheet 20)
N
T. 120 N.
KANDIYOHI COUNTY
18
19
30
31
1178
612B
1192
1178
1391B
613
548
1183
525
423
1391B
805C2
1097
1096
875C
875B
39A
1384
525
875B
611D
1097
525
41A
875C
1097
548
1096
875B
875B
875C
1097
35
804B
35
1097
1096
875B
875C
35
875B
1096
35
875B
875B
875C
35
875B
613
35
1097
1391B
613
539
875B
415
1097
525
805C2
805C2
525
1178
612B
539
875B
1406
1178
1097
805C2
805C2
612B
1030
1175
875B
1030
539
1199
1097
1183
875B
805C2
1391B
805C2
875C
525
1183
539
875B
1175
1097
875B
612B
1178
548
41A
805C2
887B
525
1183
875B
1178
909C2
887B
41A
1098
1097
399

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 16


N
(Joins sheet 11)
(Joins sheet 15)
(Joins sheet 17)
(Joins sheet 21)
R. 32 W.
R. 31 W.
T. 120 N.
1 835 000 FEET
805 000 FEET
795 000 FEET
1 810 000 FEET
Peterson Lake
Helga Lake
Grove Creek
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
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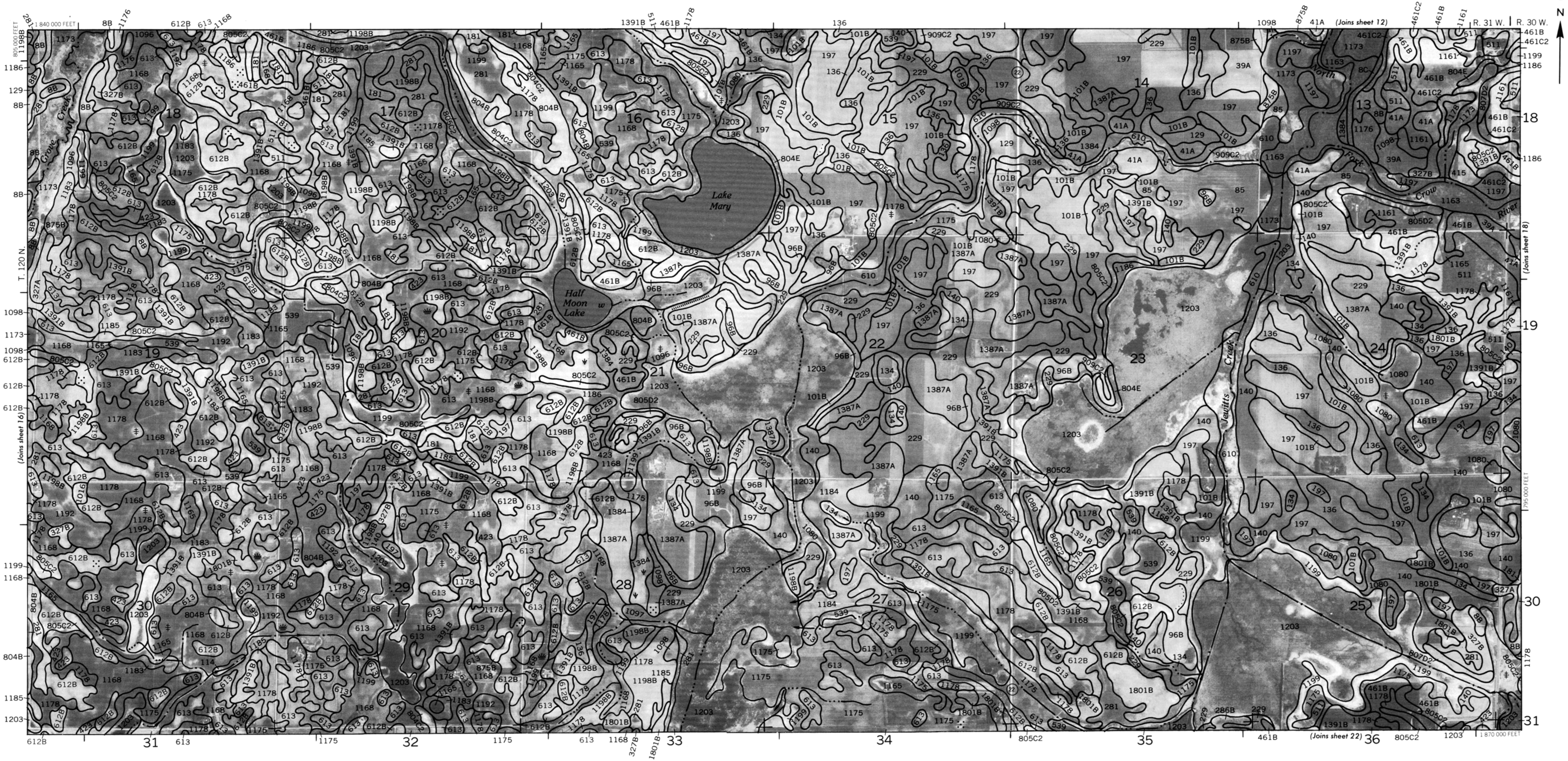
N
1 840 000 FEET
805 000 FEET
795 000 FEET
1 870 000 FEET
(Joins sheet 12)
(Joins sheet 16)
(Joins sheet 18)
(Joins sheet 22)
T. 120 N.
R. 31 W.
R. 30 W.
Crow Creek
North Fork Crow River
Jewitts Creek
Lake Mary
Half Moon Lake
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
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31
32
33
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35
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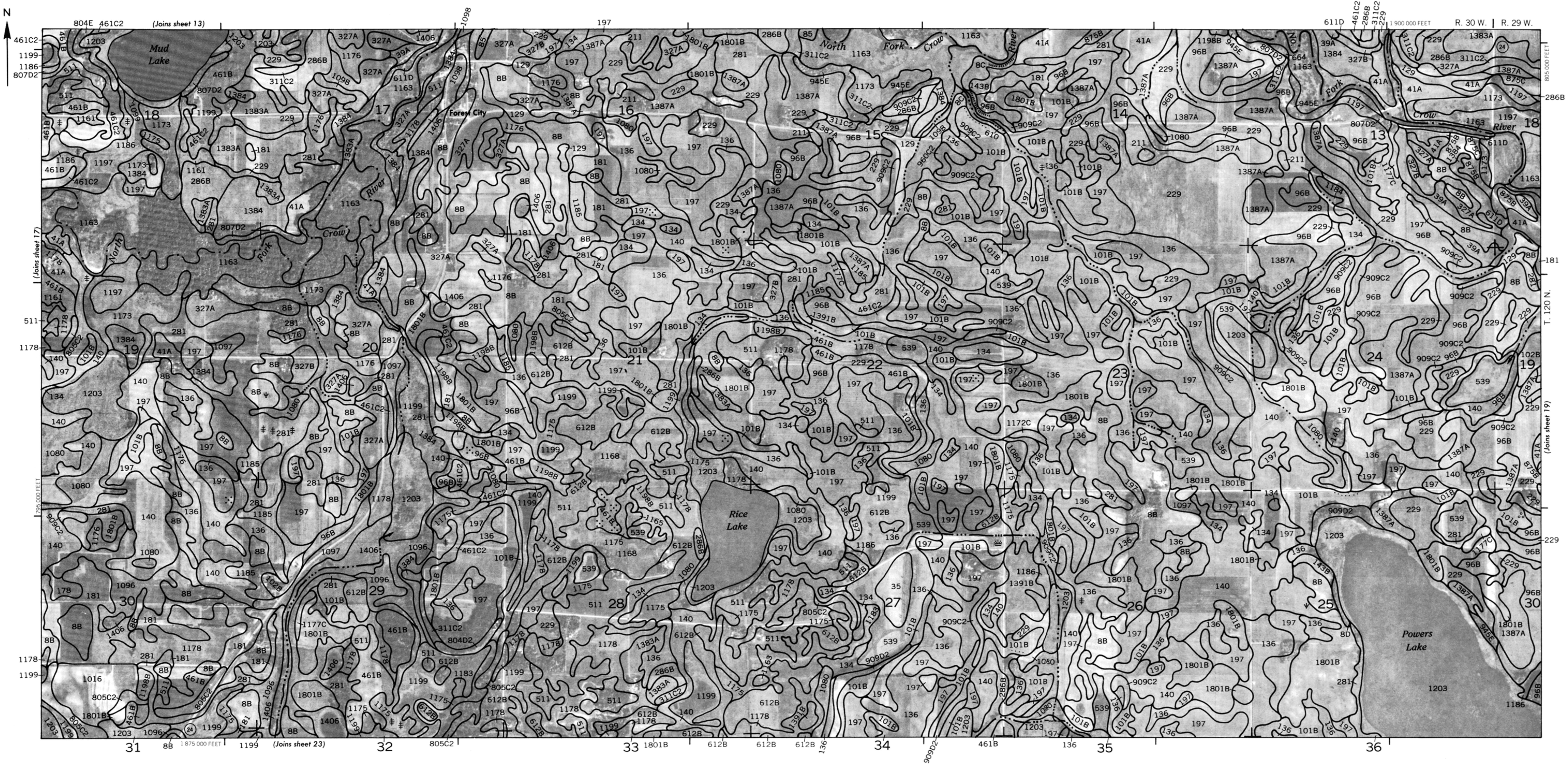
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 18


N
(Joins sheet 13)
(Joins sheet 17)
(Joins sheet 19)
(Joins sheet 23)
R. 30 W.
R. 29 W.
T. 120 N.
1 900 000 FEET
805 000 FEET
795 000 FEET
1 875 000 FEET
Mud Lake
North Fork Crow River
Forest City
Rice Lake
Powers Lake
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
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32
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34
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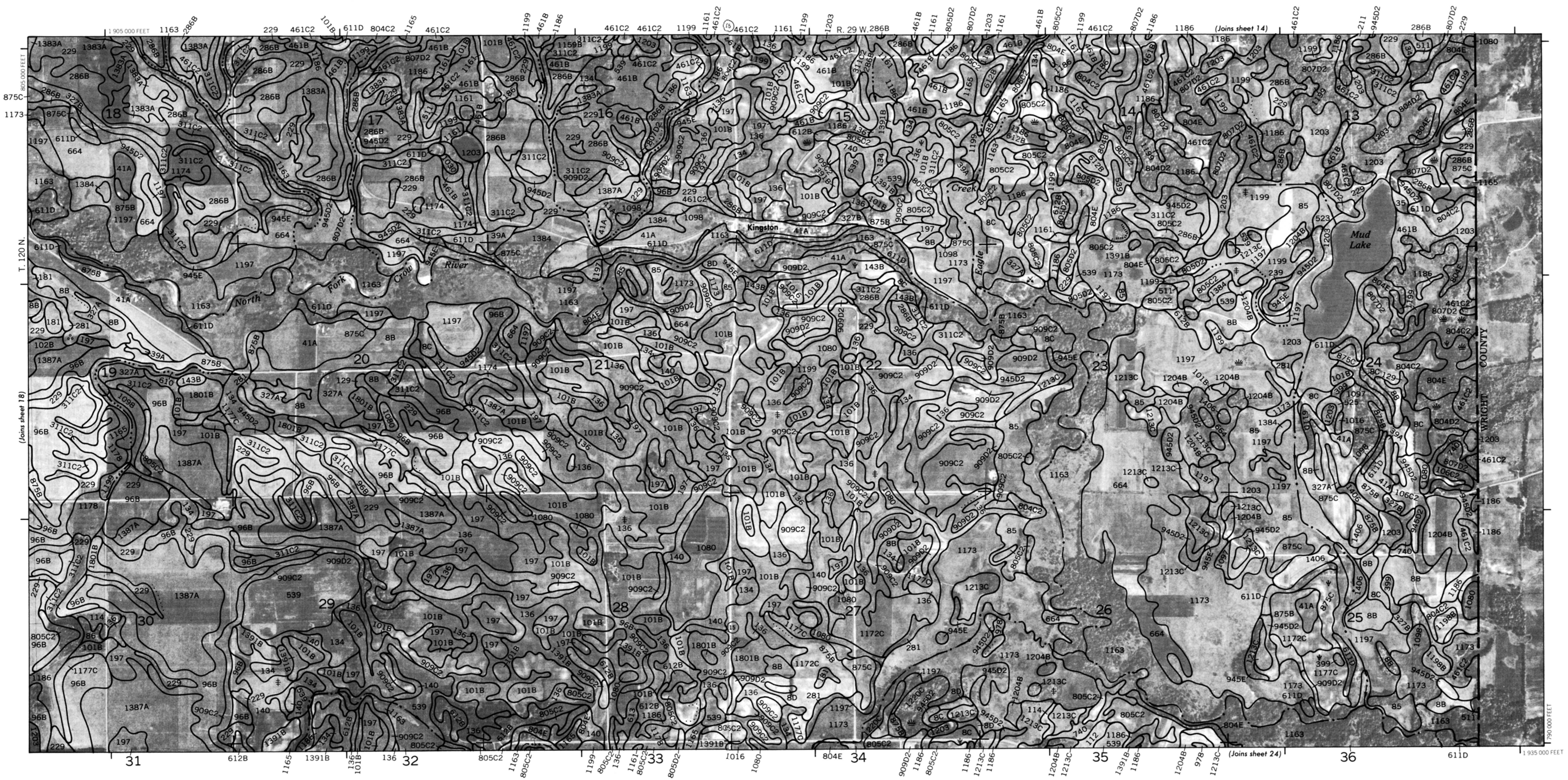
36

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 19



N
1 905 000 FEET
805 000 FEET
790 000 FEET
1 935 000 FEET
R. 29 W.
T. 120 N.
(Joins sheet 14)
(Joins sheet 18)
(Joins sheet 24)
WRIGHT COUNTY
Kingston
North Fork Crow River
Eagle Creek
Mud Lake
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
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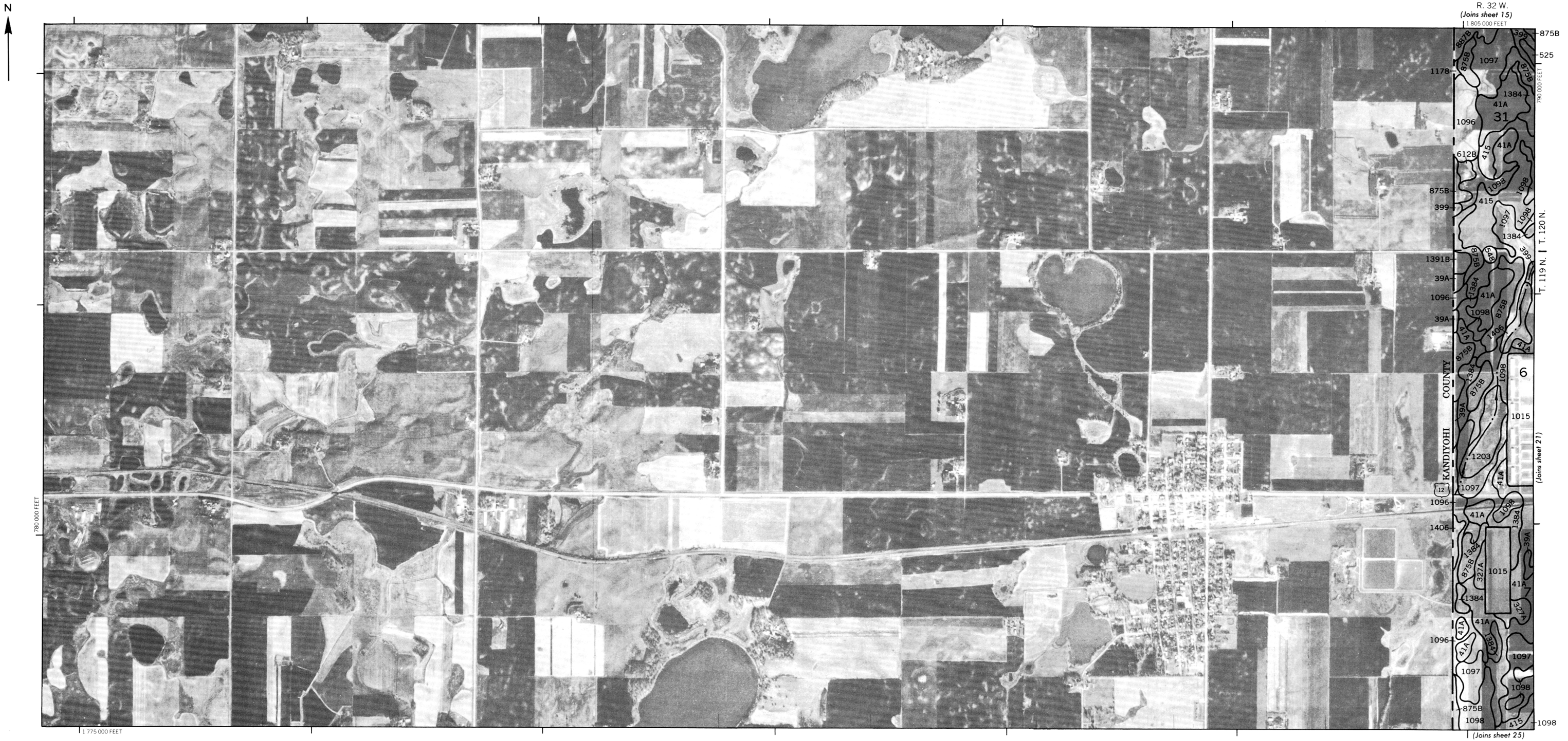
36

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 20


N
R. 32 W.
(Joins sheet 15)
1 805 000 FEET
790 000 FEET
780 000 FEET
1 775 000 FEET
T. 120 N.
T. 119 N.
(Joins sheet 21)
(Joins sheet 25)
KANDIYOHI COUNTY
12
31
6
887B
875B
1097
1178
399
875B
525
875B
1384
41A
1096
415
41A
612B
1098
1098
875B
415
399
1097
1098
1384
399
1391B
875B
548
39A
1384
41A
1096
1098
875B
39A
41A
1406
41A
875B
1384
875B
1098
39A
1015
1203
41A
1097
1096
1098
41A
1384
1406
1384
39A
875B
327A
1015
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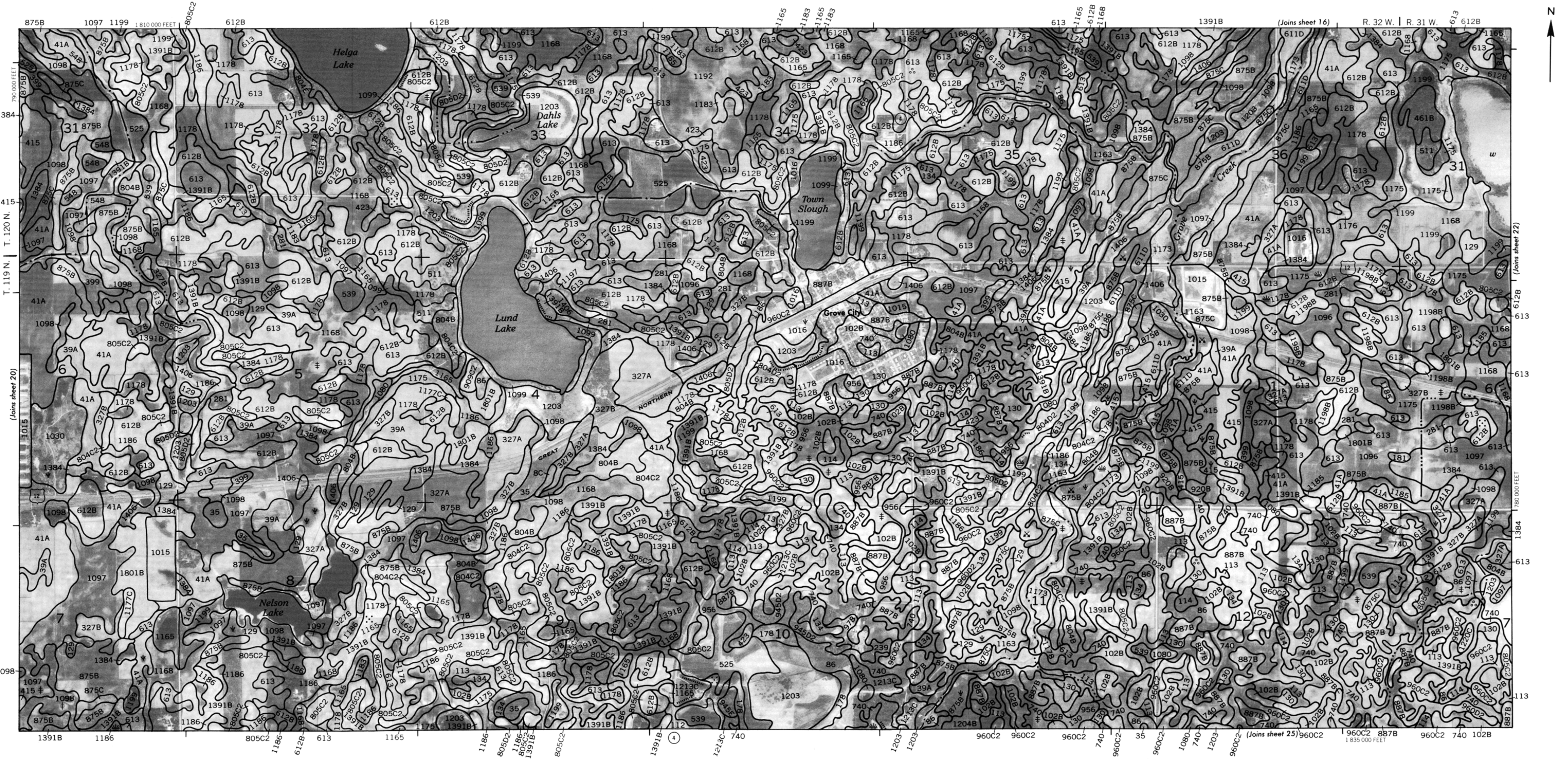
1098
875B
1098
415
1098


N
(Joins sheet 16)
(Joins sheet 20)
(Joins sheet 22)
(Joins sheet 25)
R. 32 W.
R. 31 W.
T. 120 N.
T. 119 N.
1 810 000 FEET
1 835 000 FEET
790 000 FEET
780 000 FEET
Helga Lake
Dahls Lake
Town Slough
Lund Lake
Nelson Lake
Grove City
Grove Creek
GREAT NORTHERN
12
4

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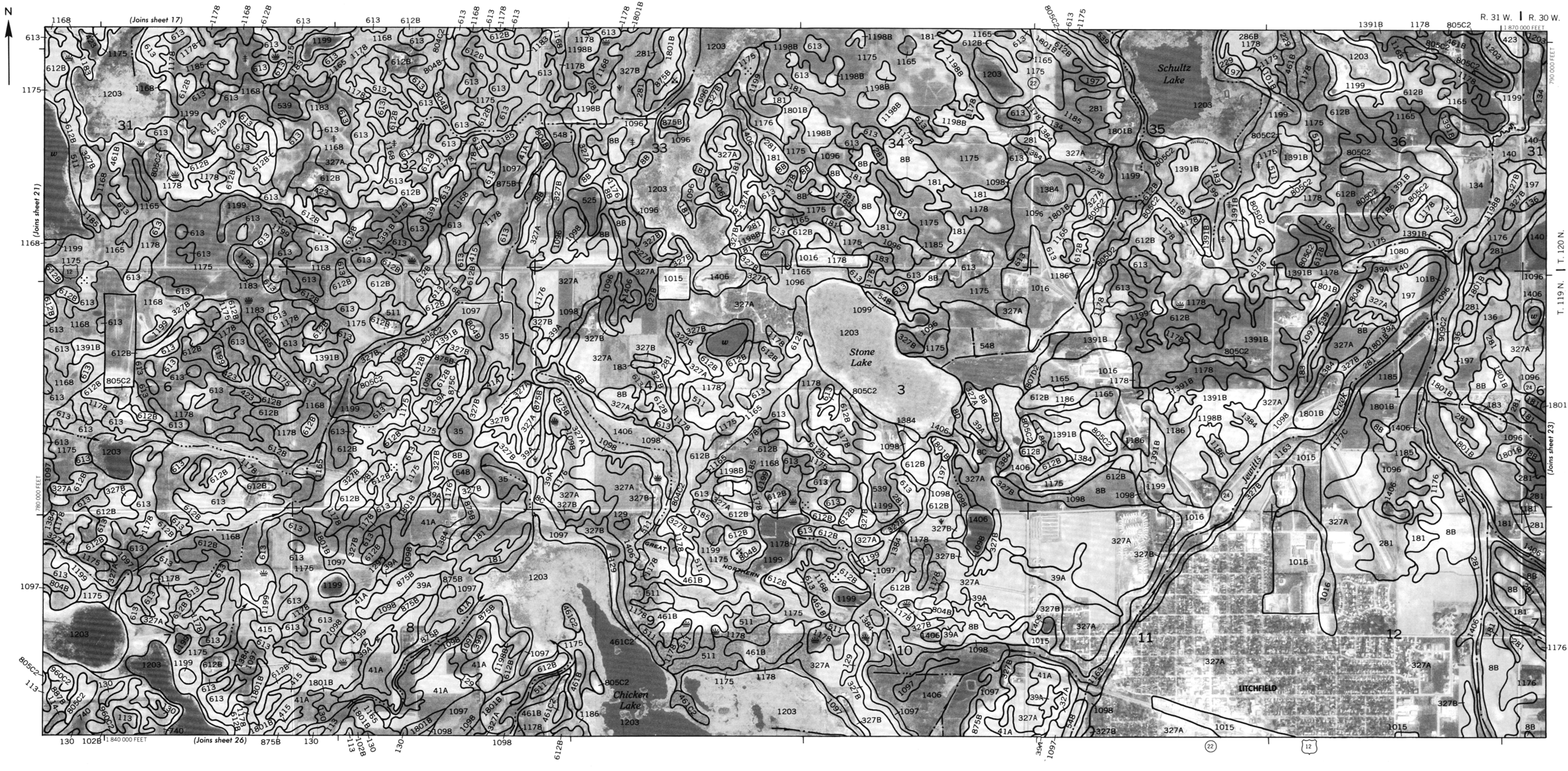
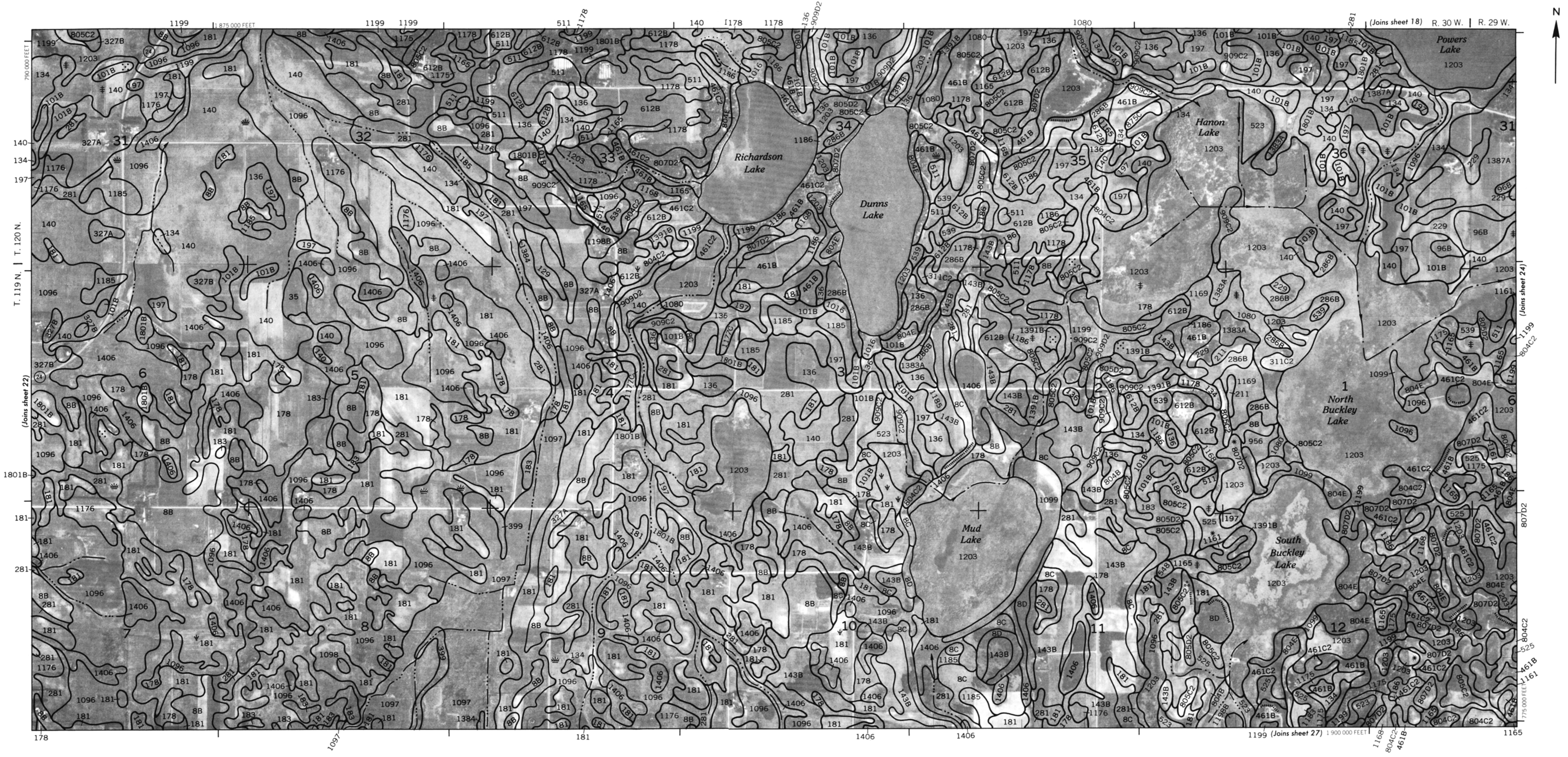
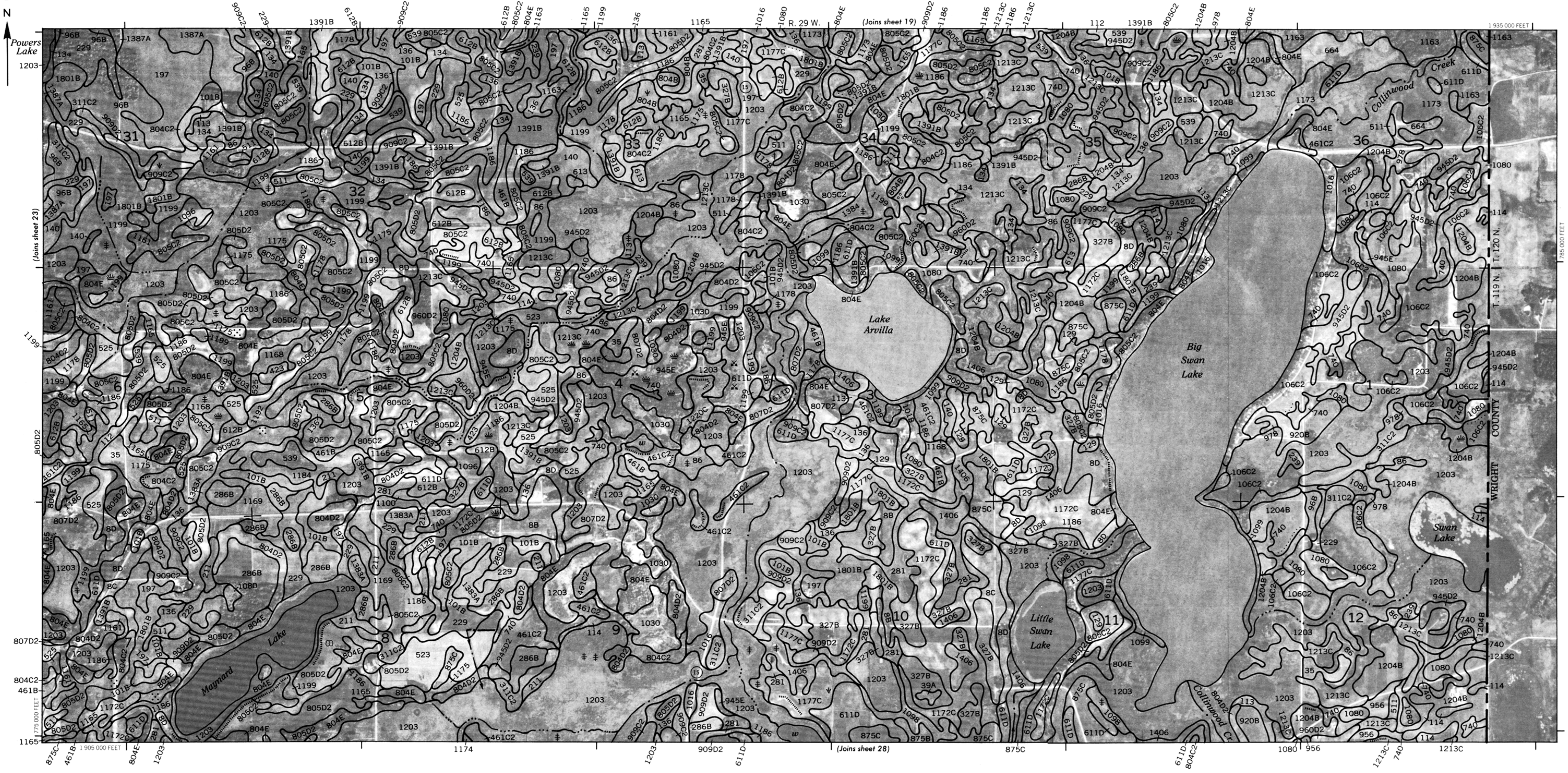
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 22


N
(Joins sheet 17)
(Joins sheet 21)
(Joins sheet 23)
(Joins sheet 26)
R. 31 W.
R. 30 W.
T. 120 N.
T. 119 N.
1 870 000 FEET
790 000 FEET
1 840 000 FEET
780 000 FEET
Schultz Lake
Stone Lake
Chicken Lake
LITCHFIELD
Jewitts Creek
GREAT NORTHERN
31
32
33
34
35
36
6
5
4
3
2
1
7
8
9
10
11
12
22
24
12

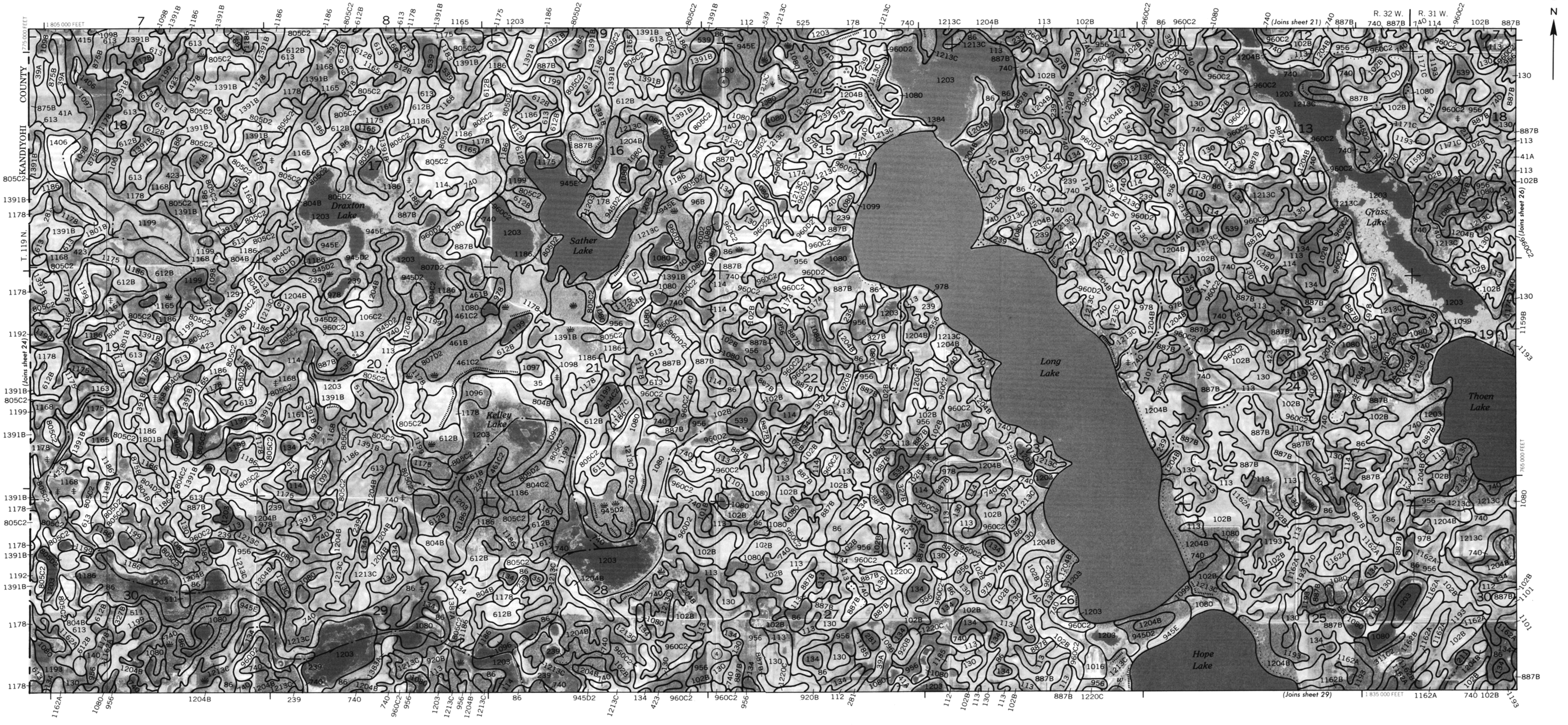
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 23


N
(Joins sheet 18)
R. 30 W.
R. 29 W.
(Joins sheet 22)
(Joins sheet 24)
(Joins sheet 27)
T. 120 N.
T. 119 N.
1 875 000 FEET
1 900 000 FEET
790 000 FEET
775 000 FEET
Powers Lake
Richardson Lake
Dunns Lake
Hanon Lake
North Buckley Lake
South Buckley Lake
Mud Lake
31
32
33
34
35
36
31
6
5
4
3
2
1
6
7
8
9
10
11
12
24
24

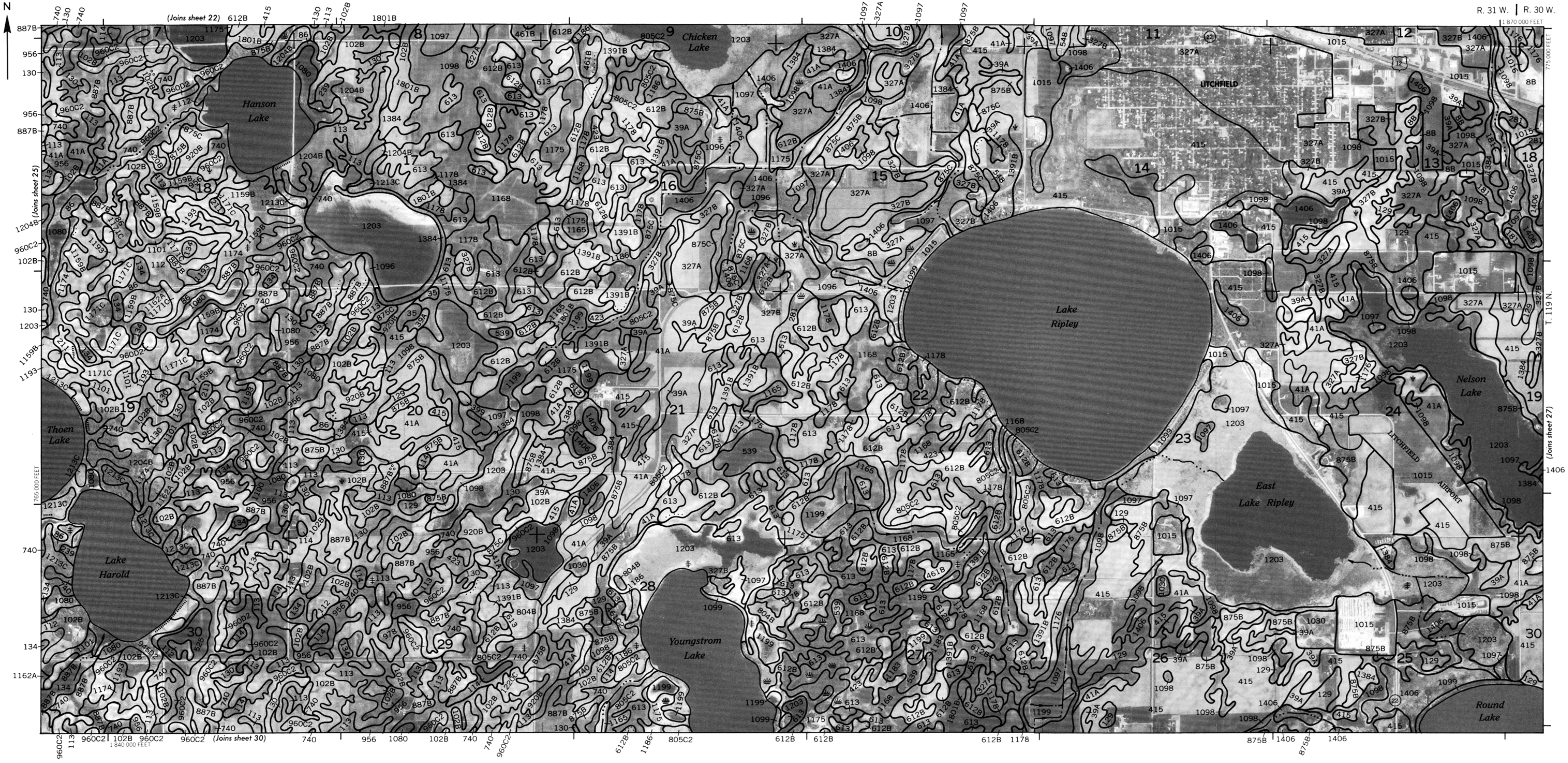
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 24

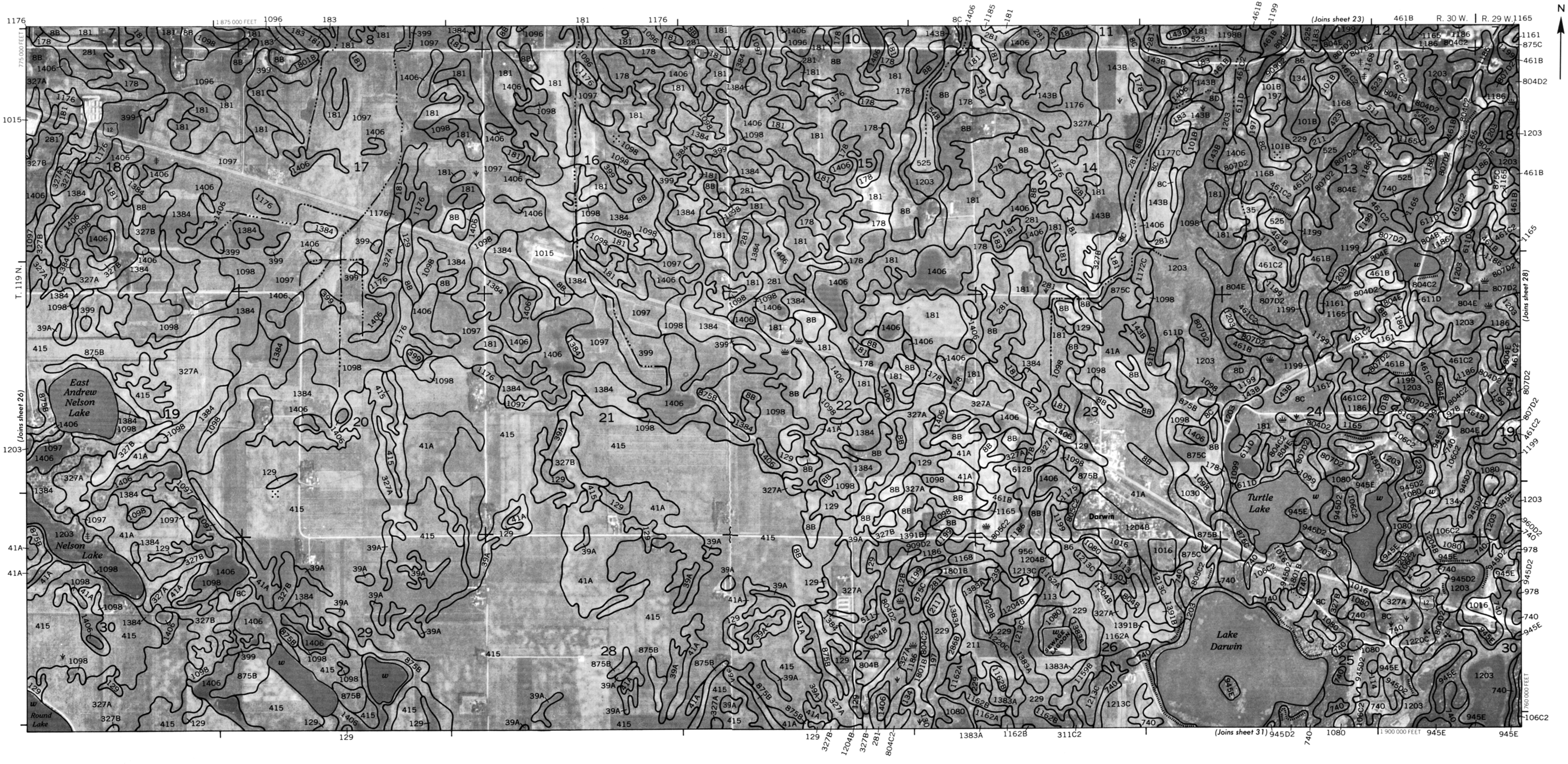

N
Powers Lake
909C2
229
1391B
612B
909C2
612B
805C2
804E
1163
1165
1199
136
1165
1016
1080
R. 29 W.
804E
(Joins sheet 19)
909D2
1186
1186
1213C
1186
1213C
112
1391B
805C2
1204B
978
804E
1 935 000 FEET
(Joins sheet 23)
1203
1199
805D2
807D2
804C2
461B
1165
775 000 FEET
1 905 000 FEET
875C
461B
804E
1203
1174
1203
909D2
611D
(Joins sheet 28)
875C
611D
804C2
1080
956
1213C
740
1213C
1163
1080
114
785 000 FEET
T. 120 N.
T. 119 N.
1204B
945D2
114
WRIGHT COUNTY
740
1213C
114
31
32
33
34
35
36
6
5
4
3
2
1
7
8
9
10
11
12
Collinwood Creek
Lake Arvilla
Big Swan Lake
Little Swan Lake
Swan Lake
Maynard Lake
Collinwood Cr.
15

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 25

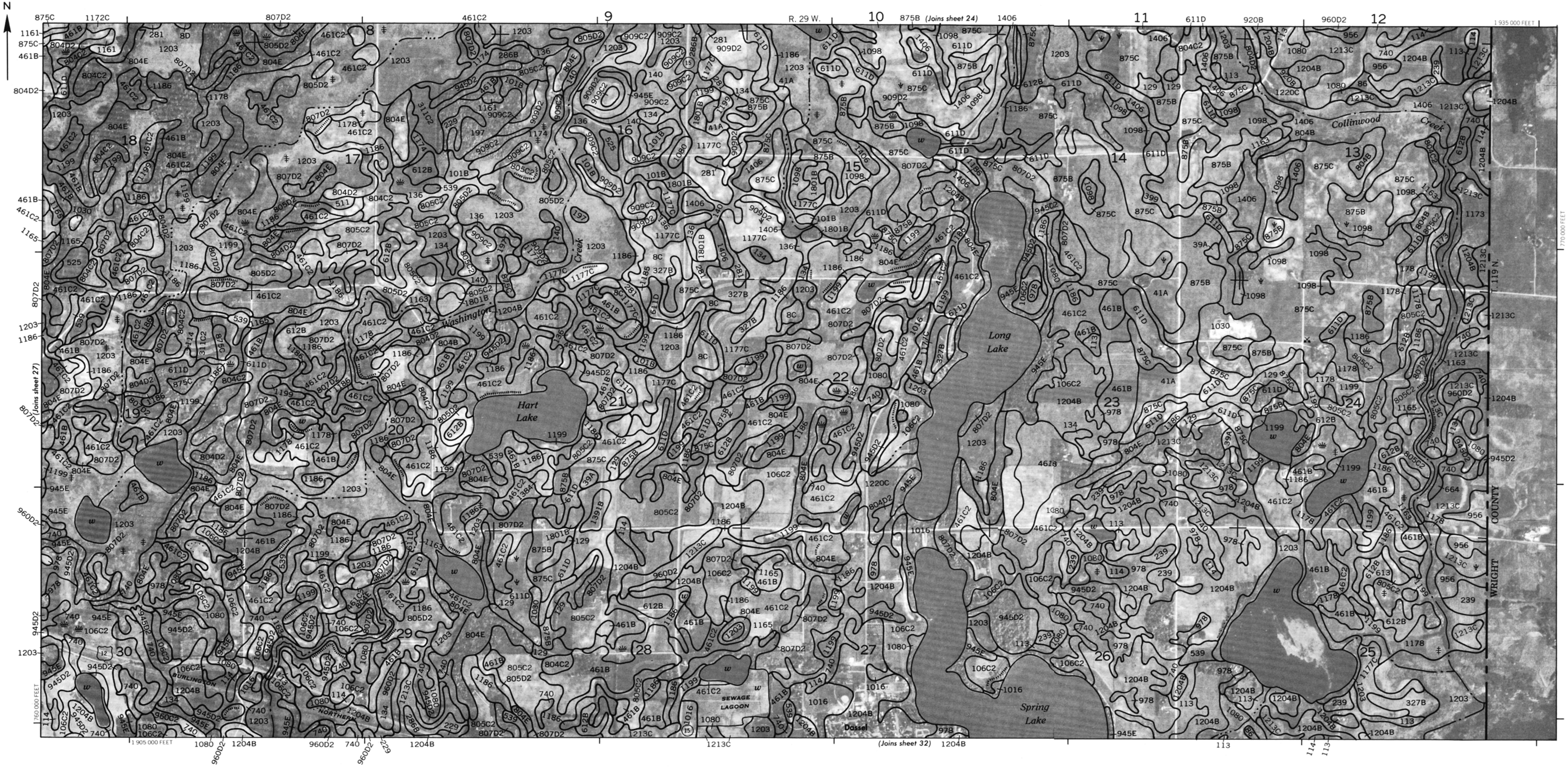

N
KANDIYOHI COUNTY
T. 119 N.
R. 32 W.
R. 31 W.
1 805 000 FEET
1 835 000 FEET
175 000 FEET
765 000 FEET
(Joins sheet 21)
(Joins sheet 24)
(Joins sheet 26)
(Joins sheet 29)
Draxton Lake
Sather Lake
Kelley Lake
Long Lake
Grass Lake
Thoen Lake
Hope Lake
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 26

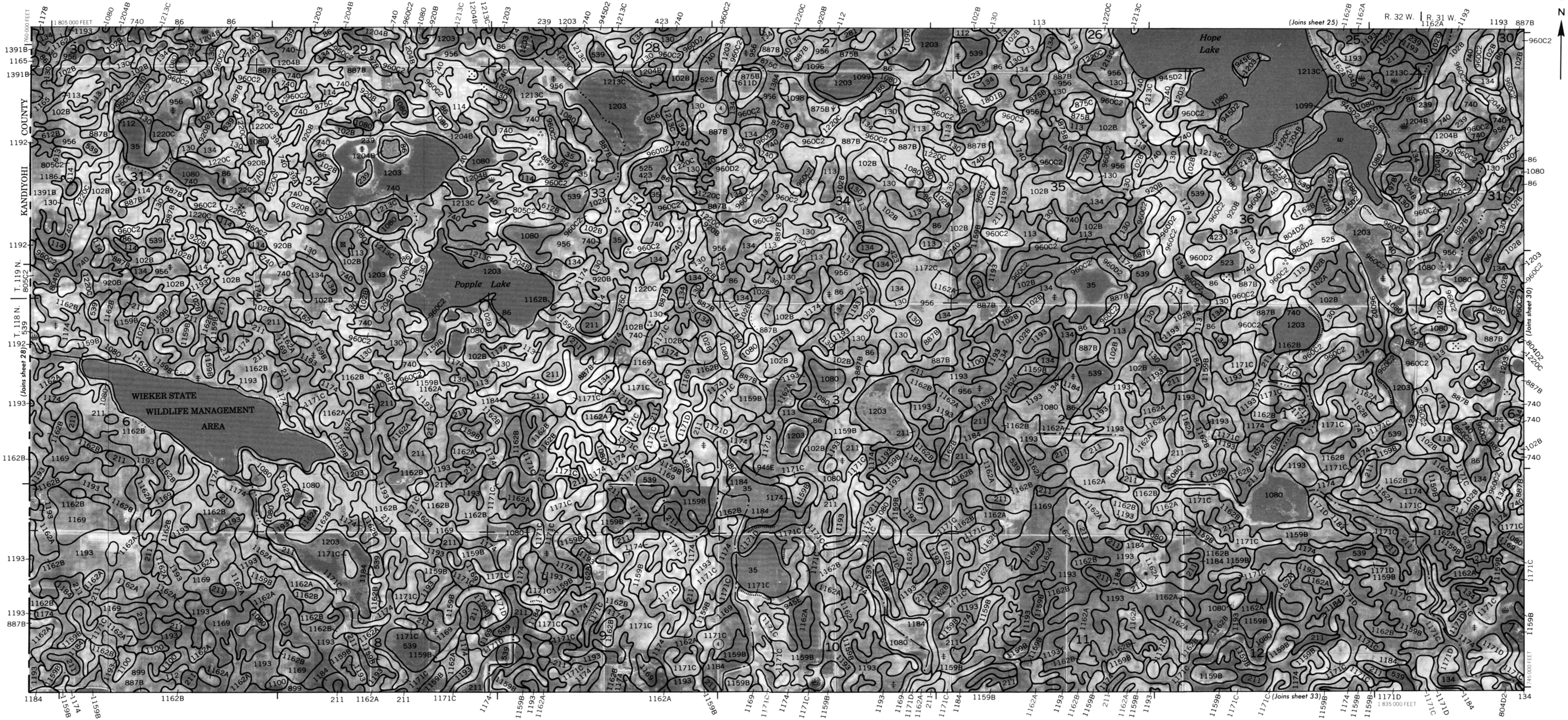

N
(Joins sheet 22)
(Joins sheet 25)
(Joins sheet 27)
(Joins sheet 30)
R. 31 W.
R. 30 W.
T. 119 N.
1 870 000 FEET
775 000 FEET
765 000 FEET
1 840 000 FEET
Hanson Lake
Chicken Lake
LITCHFIELD
Lake Ripley
East Lake Ripley
Nelson Lake
Thoen Lake
Lake Harold
Youngstrom Lake
Round Lake
LITCHFIELD AIRPORT
12
22
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30


N
(Joins sheet 23)
(Joins sheet 28)
(Joins sheet 31)
(Joins sheet 26)
R. 30 W.
R. 29 W.
T. 119 N.
1 875 000 FEET
1 900 000 FEET
775 000 FEET
760 000 FEET
East Andrew Nelson Lake
Nelson Lake
Round Lake
Turtle Lake
Lake Darwin
Darwin
SEWAGE LAGOON
7
8
9
10
11
12
18
17
16
15
14
13
19
20
21
22
23
24
30
29
28
27
26
25

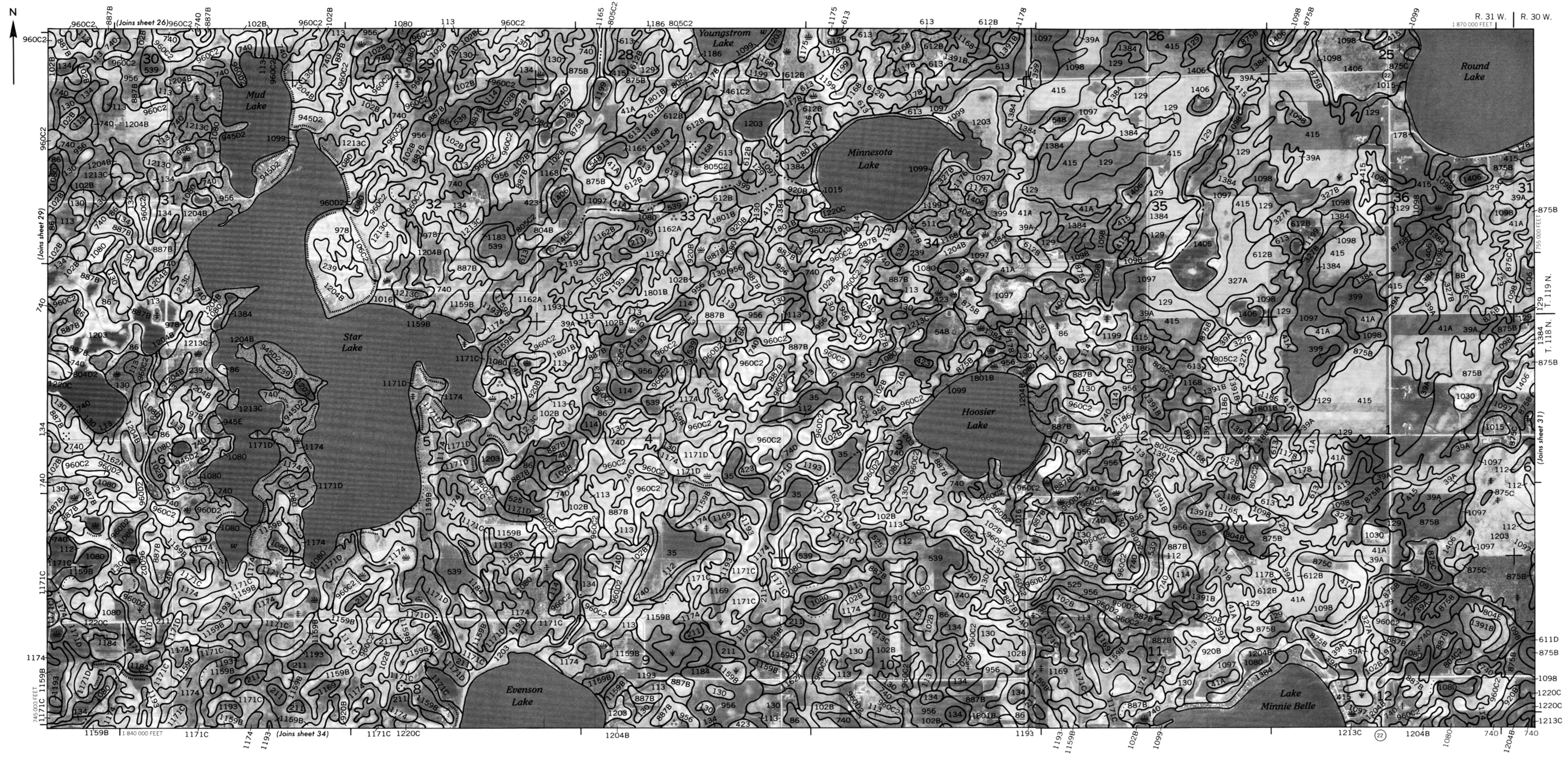
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 28


N
R. 29 W.
(Joins sheet 24)
(Joins sheet 27)
(Joins sheet 32)
T. 119 N.
WRIGHT COUNTY
1 905 000 FEET
1 935 000 FEET
760 000 FEET
770 000 FEET
Hart Lake
Long Lake
Spring Lake
Washington Creek
Collinwood Creek
Dassel
SEWAGE LAGOON
BURLINGTON NORTHERN
12
15
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30

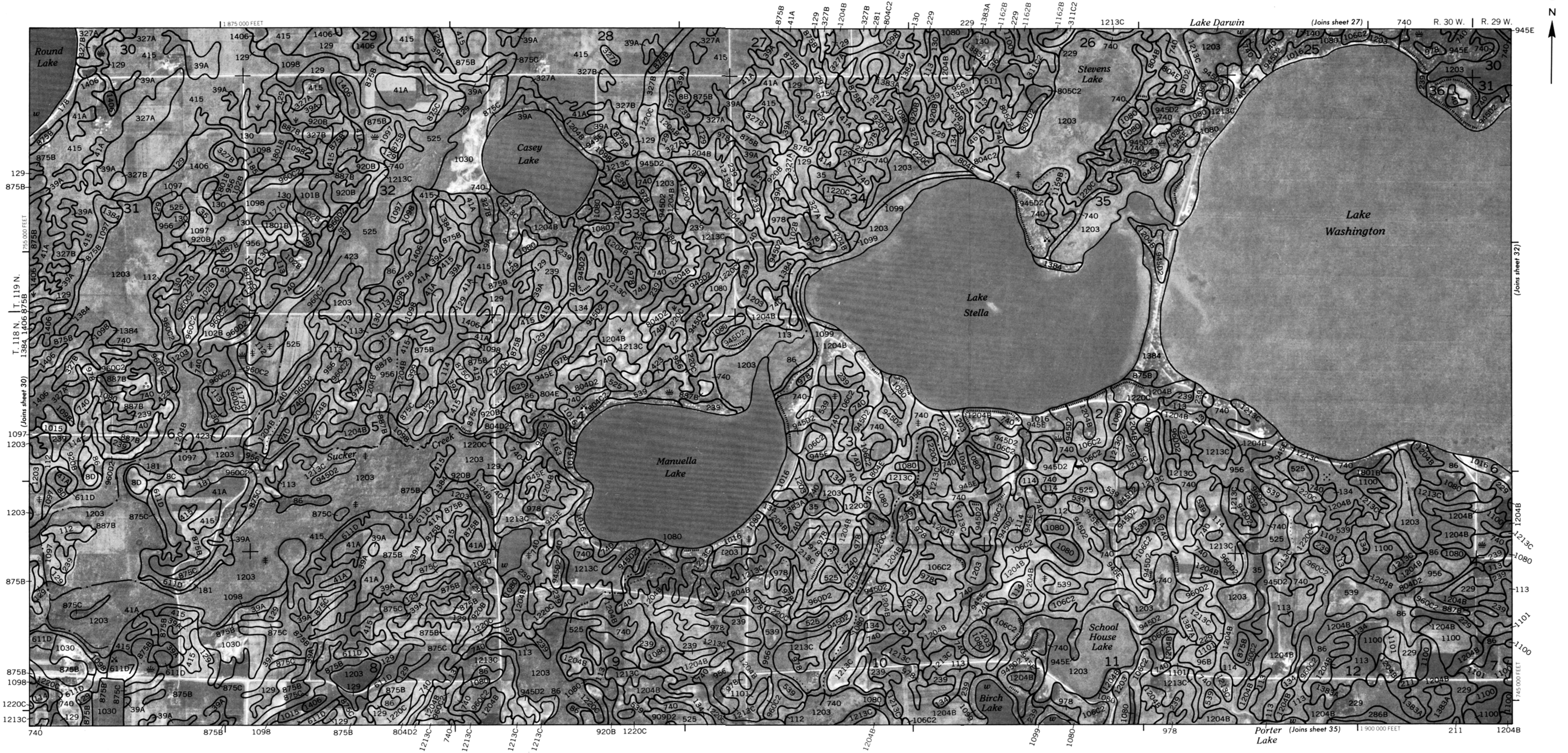
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 29


N
(Joins sheet 25)
(Joins sheet 28)
(Joins sheet 30)
(Joins sheet 33)
R. 32 W.
R. 31 W.
T. 119 N.
T. 118 N.
KANDIYOHI COUNTY
1 805 000 FEET
1 835 000 FEET
760 000 FEET
745 000 FEET
Hope Lake
Popple Lake
WIEKER STATE WILDLIFE MANAGEMENT AREA
w

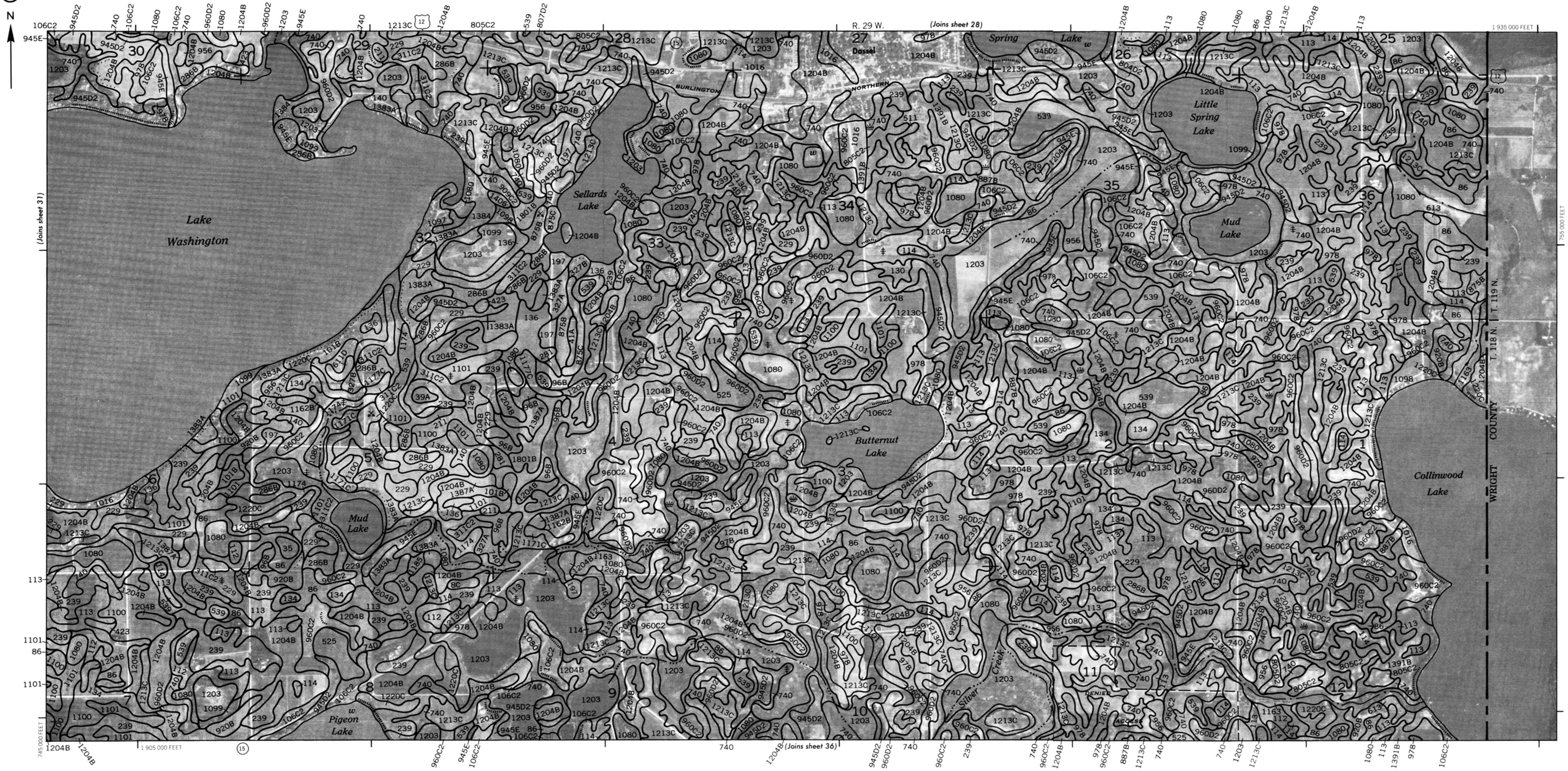
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 30

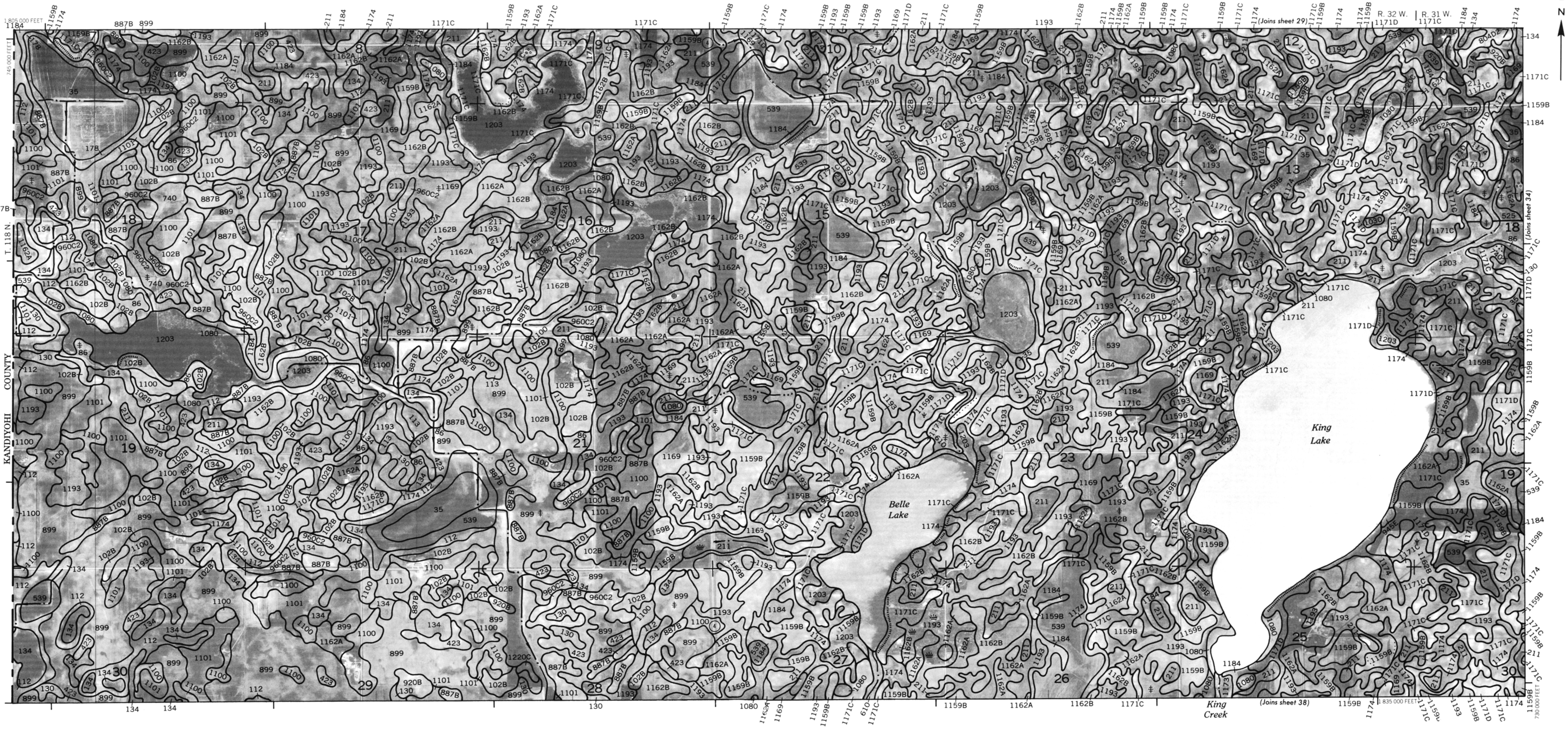

N
(Joins sheet 26)
(Joins sheet 29)
(Joins sheet 31)
(Joins sheet 34)
R. 31 W.
R. 30 W.
T. 119 N.
T. 118 N.
1 870 000 FEET
755 000 FEET
1 840 000 FEET
745 000 FEET
Mud Lake
Youngstrom Lake
Minnesota Lake
Round Lake
Star Lake
Hoosier Lake
Evenson Lake
Lake Minnie Belle
26
25
27
28
29
30
31
32
33
34
35
36
1
2
3
4
5
6
7
8
9
10
11
12
22

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA · SHEET NUMBER 31

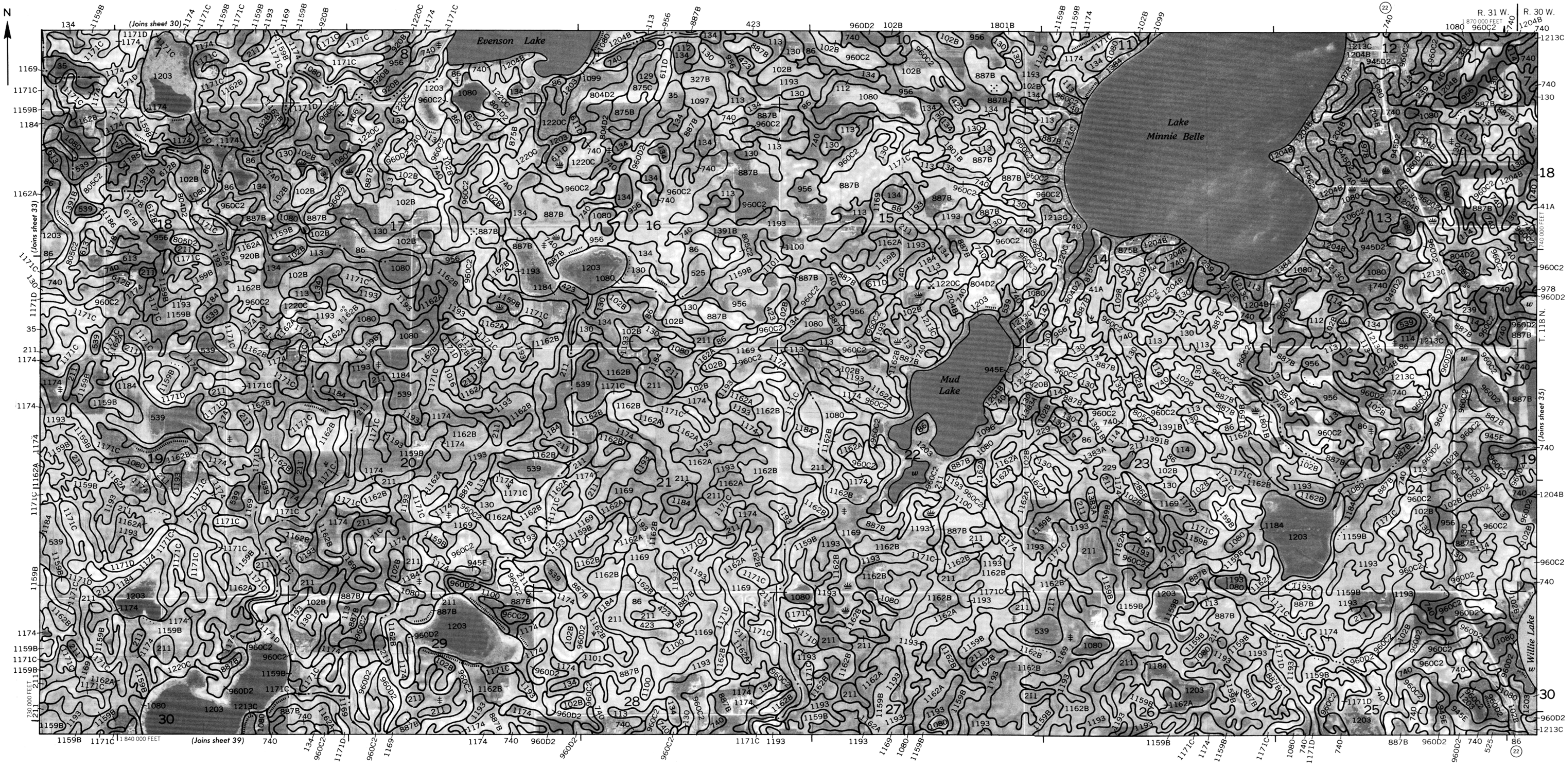

N
1 875 000 FEET
1 900 000 FEET
755 000 FEET
745 000 FEET
R. 30 W.
R. 29 W.
T. 119 N.
T. 118 N.
(Joins sheet 27)
(Joins sheet 32)
(Joins sheet 35)
(Joins sheet 30)
Round Lake
Casey Lake
Stevens Lake
Lake Darwin
Lake Washington
Lake Stella
Manuella Lake
Sucker Creek
School House Lake
Birch Lake
Porter Lake
30
29
28
27
26
25
31
32
33
34
35
36
6
5
4
3
2
1
7
8
9
10
11
12

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 32


N
R. 29 W.
(Joins sheet 28)
(Joins sheet 31)
(Joins sheet 36)
1 935 000 FEET
755 000 FEET
745 000 FEET
1 905 000 FEET
T. 119 N.
T. 118 N.
WRIGHT COUNTY
Lake Washington
Sellards Lake
Dassel
Burlington
Northern
Spring Lake
Little Spring Lake
Mud Lake
Butternut Lake
Collinwood Lake
Mud Lake
Pigeon Lake
Silver Creek
Denier
12
15
30
29
28
27
26
25
32
33
34
35
36
6
5
4
3
2
1
7
8
9
10
11
12


1 805 000 FEET
745 000 FEET
(Joins sheet 29)
R. 32 W.
R. 31 W.
N
(Joins sheet 34)
T. 118 N.
KANDIYOHI COUNTY
King Lake
Belle Lake
King Creek
(Joins sheet 38)
1 835 000 FEET
720 000 FEET

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 34


N
(Joins sheet 30)
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 39)
R. 31 W.
R. 30 W.
T. 118 N.
1 870 000 FEET
1 840 000 FEET
740 000 FEET
730 000 FEET
Evenson Lake
Lake Minnie Belle
Mud Lake
Willie Lake
22
7
8
9
10
11
12
13
14
15
16
17
18
19
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23
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27
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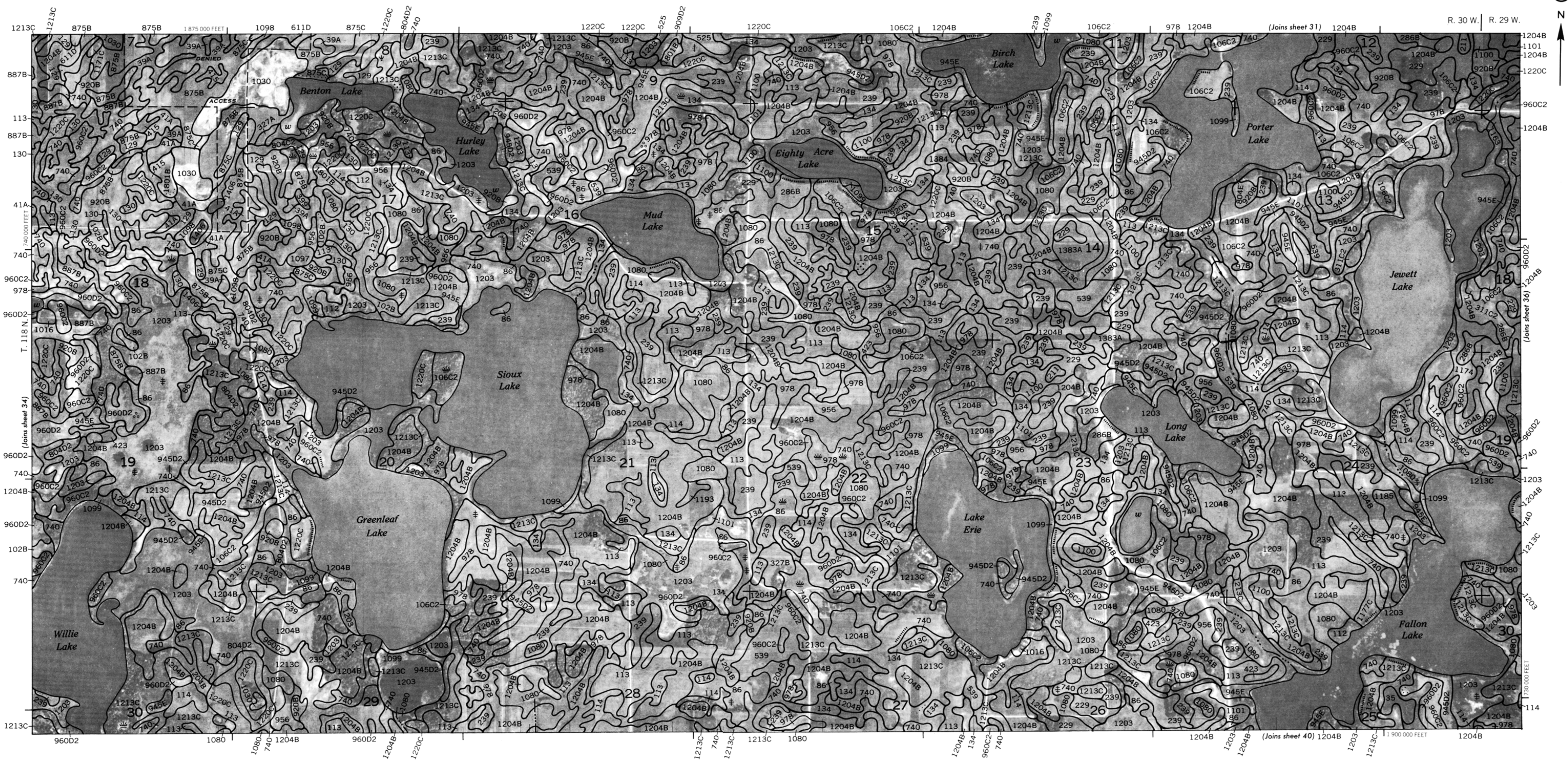
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 35


N
R. 30 W.
R. 29 W.
T. 118 N.
(Joins sheet 31)
(Joins sheet 34)
(Joins sheet 36)
(Joins sheet 40)
1 875 000 FEET
1 900 000 FEET
740 000 FEET
730 000 FEET
Benton Lake
Hurley Lake
Eighty Acre Lake
Birch Lake
Porter Lake
Mud Lake
Jewett Lake
Sioux Lake
Long Lake
Greenleaf Lake
Lake Erie
Willie Lake
Fallon Lake
ACCESS
DENIED
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
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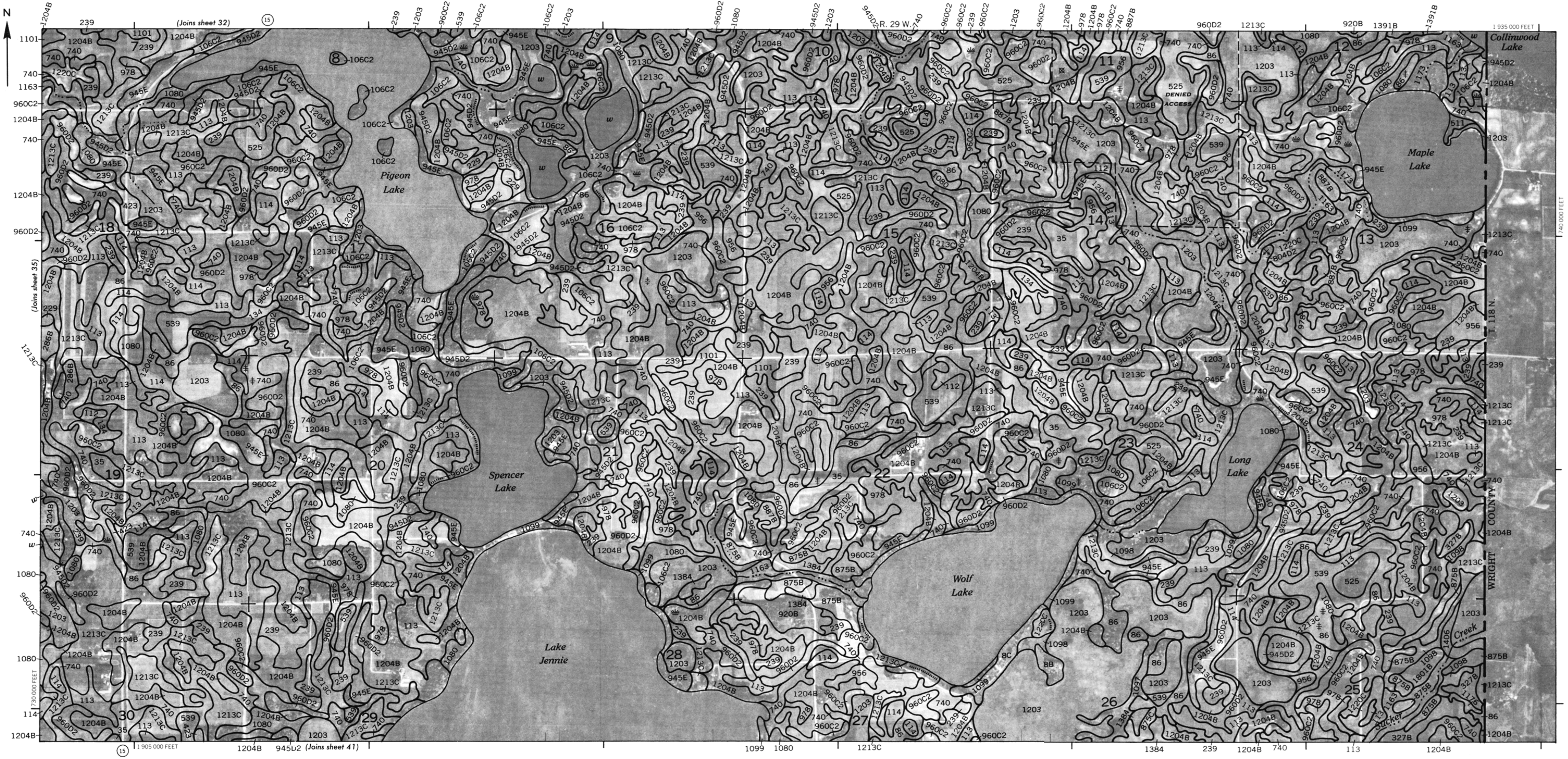
(36)

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 36


N
(Joins sheet 32)
(Joins sheet 35)
(Joins sheet 41)
R. 29 W.
T. 118 N.
WRIGHT COUNTY
1 935 000 FEET
740 000 FEET
730 000 FEET
1 905 000 FEET
15
Pigeon Lake
Spencer Lake
Lake Jennie
Wolf Lake
Long Lake
Maple Lake
Collinwood Lake
Sucker Creek
DENIED ACCESS
7
8
9
10
11
12
13
14
15
16
17
18
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20
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22
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24
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27
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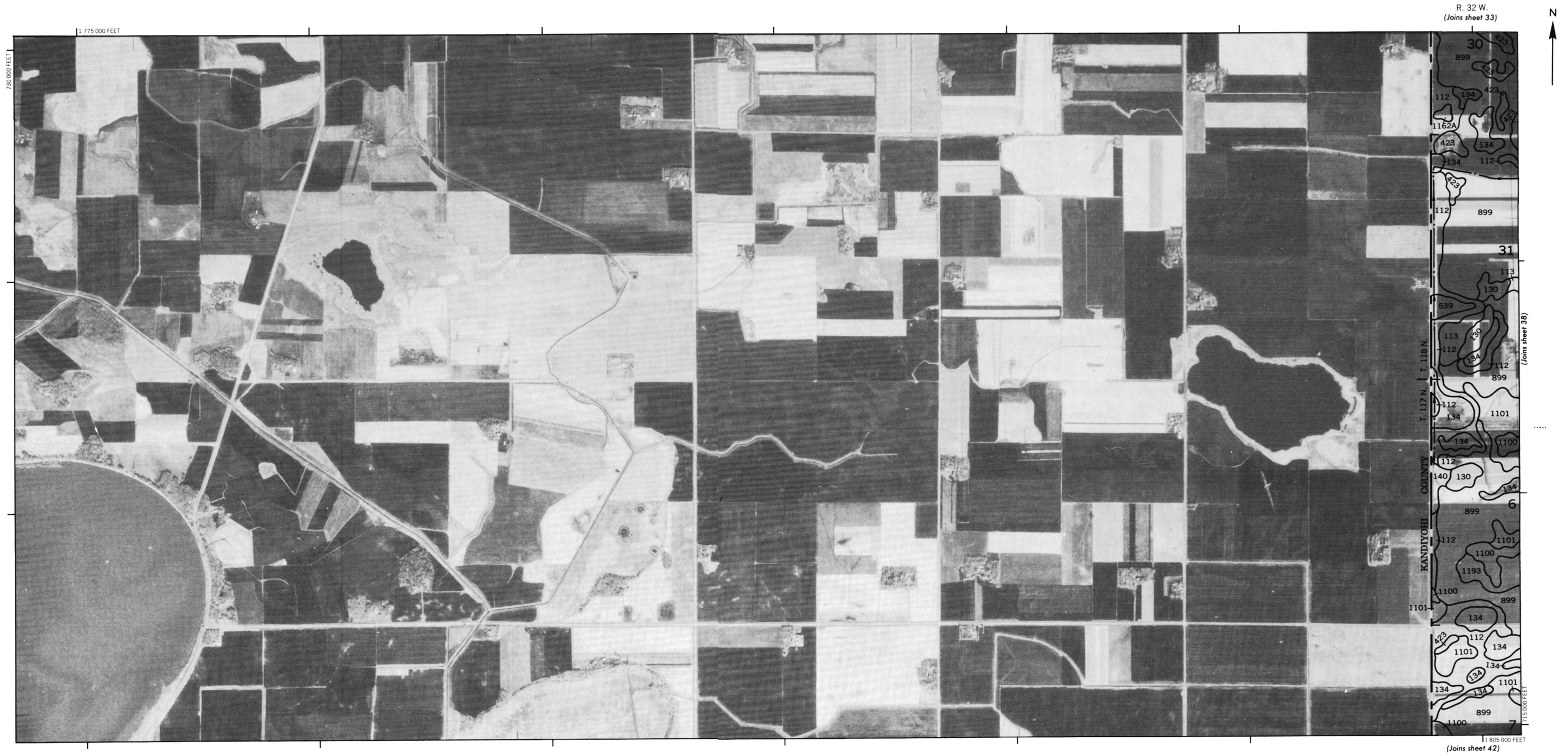
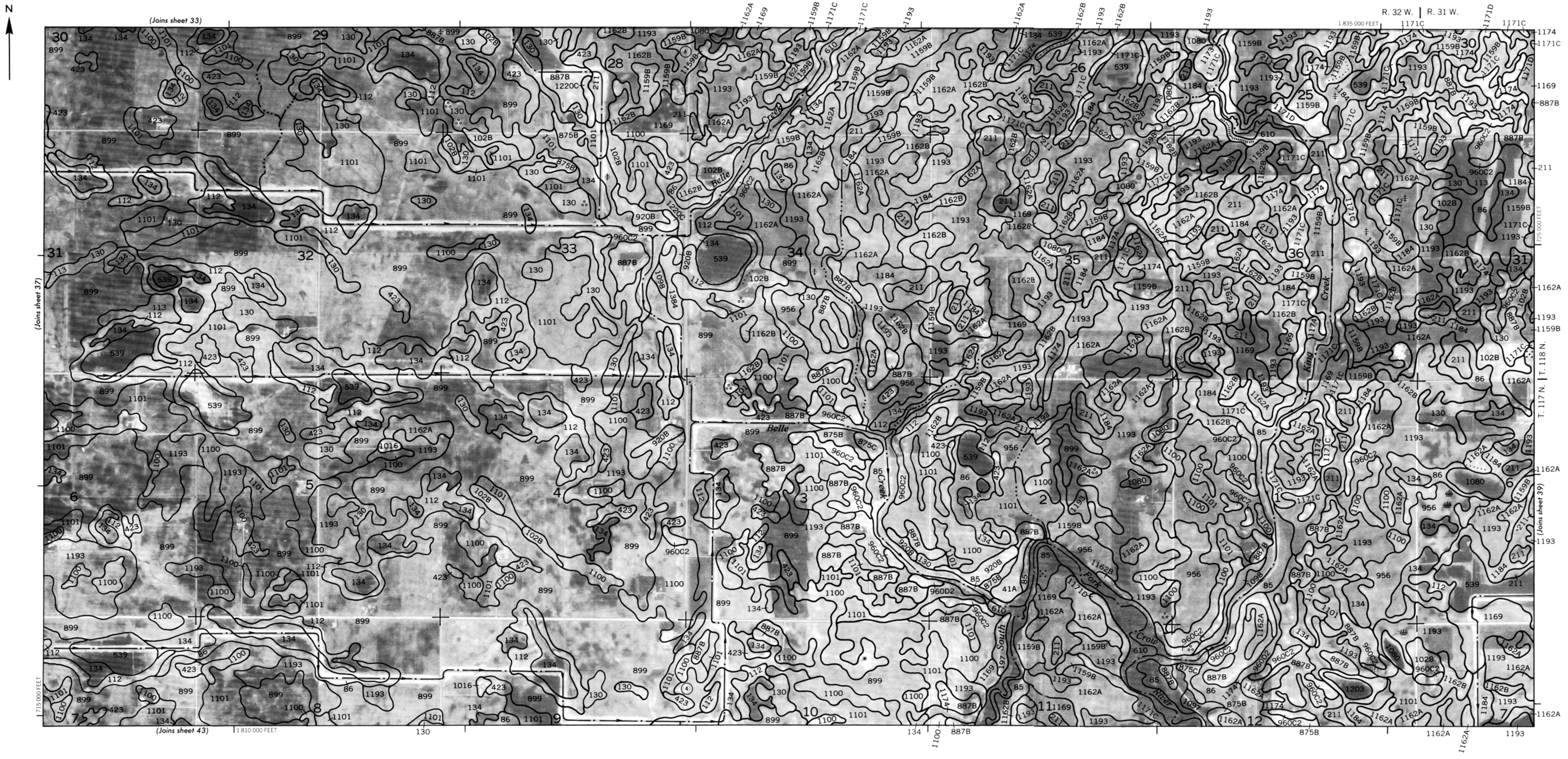
29
30

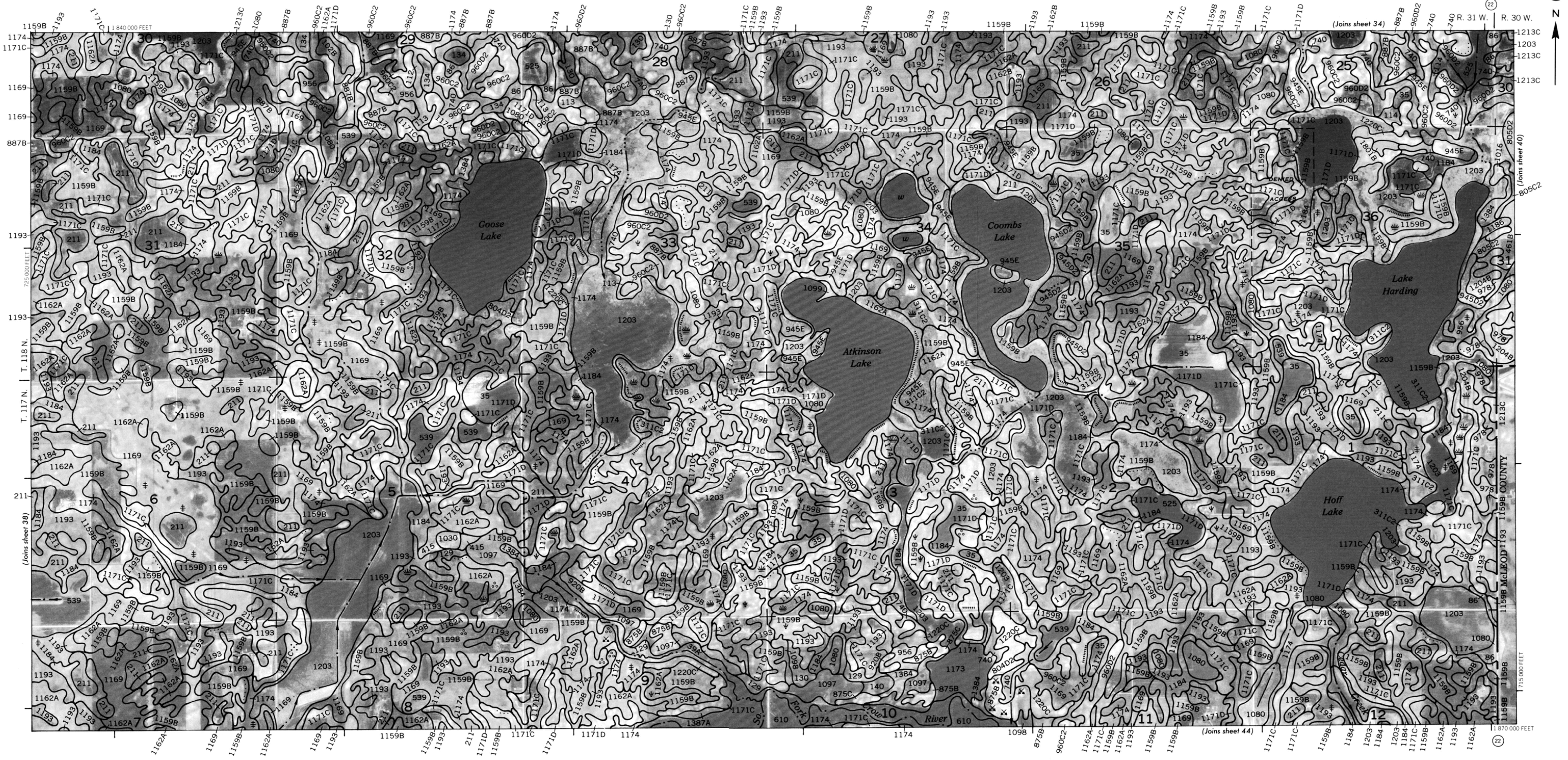
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 37



37
N
R. 32 W.
(Joins sheet 33)
(Joins sheet 38)
(Joins sheet 42)
1 775 000 FEET
1 805 000 FEET
730 000 FEET
715 000 FEET
T. 118 N.
T. 117 N.
KANDIYOHI COUNTY
30
31
6
7
899
423
423
423
423
112
134
1162A
423
134
134
112
423
112
899
113
130
539
113
130
112
134
112
899
112
134
1101
134
1100
112
140
130
134
899
112
1101
1100
1193
1100
1101
899
134
423
112
1101
134
134
134
1101
134
134
899
1100


N
(Joins sheet 33)
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 43)
R. 32 W.
R. 31 W.
T. 118 N.
T. 117 N.
1 835 000 FEET
725 000 FEET
1 810 000 FEET
715 000 FEET
Belle Creek
King Creek
South Fork Crow River
30
29
28
27
26
25
30
31
32
33
34
35
36
31
6
5
4
3
2
1
6
7
8
9
10
11
12
7

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 39


N
(Joins sheet 34)
(Joins sheet 40)
(Joins sheet 44)
(Joins sheet 38)
R. 31 W.
R. 30 W.
T. 118 N.
T. 117 N.
22
1 840 000 FEET
1 870 000 FEET
725 000 FEET
715 000 FEET
MEEKER COUNTY
McLEOD COUNTY
Goose Lake
Coombs Lake
Atkinson Lake
Lake Harding
Hoff Lake
So. Fork Crow River
Creek
CEMETERY
ACCESS
w
30
29
28
27
26
25
31
32
33
34
35
36
6
5
4
3
2
1
7
8
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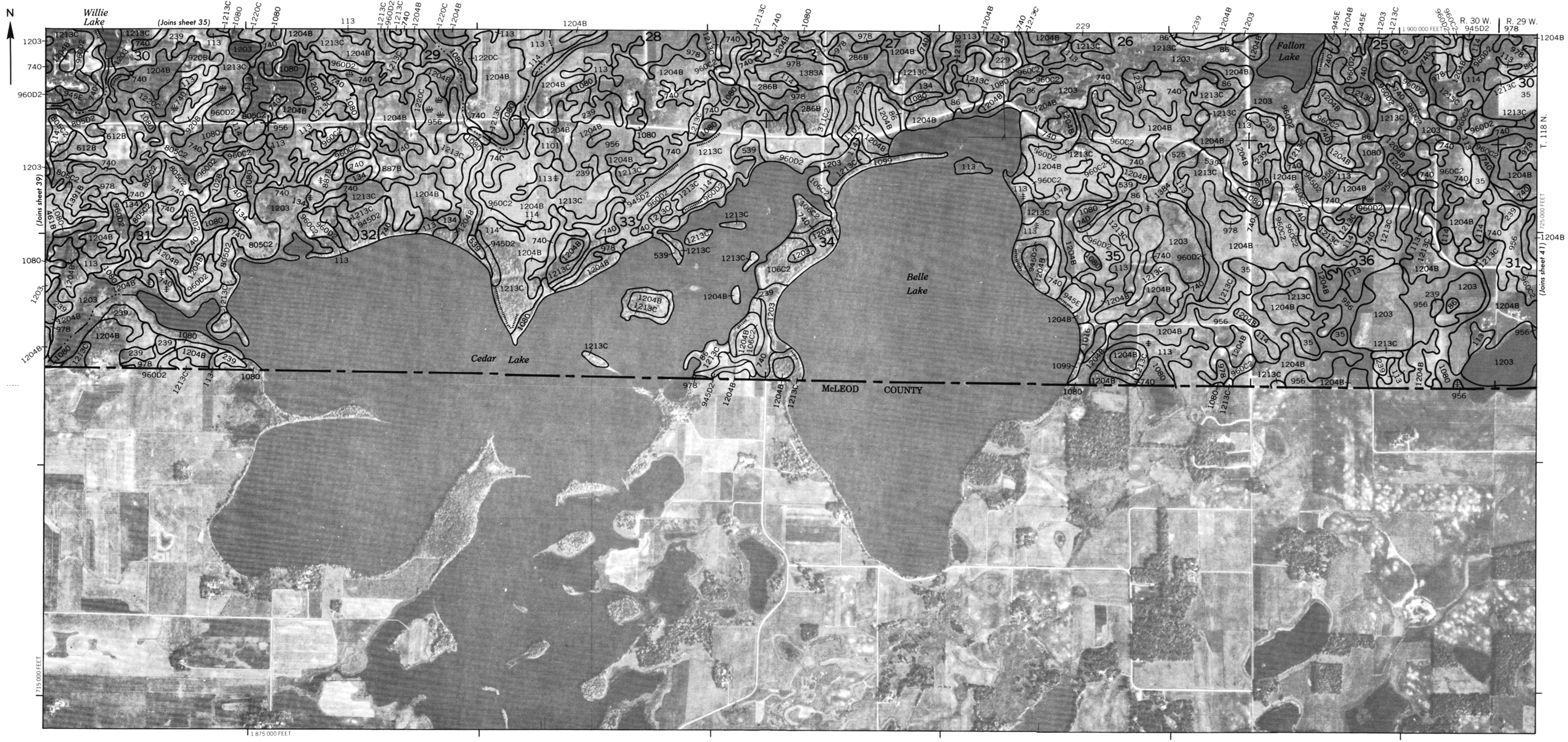
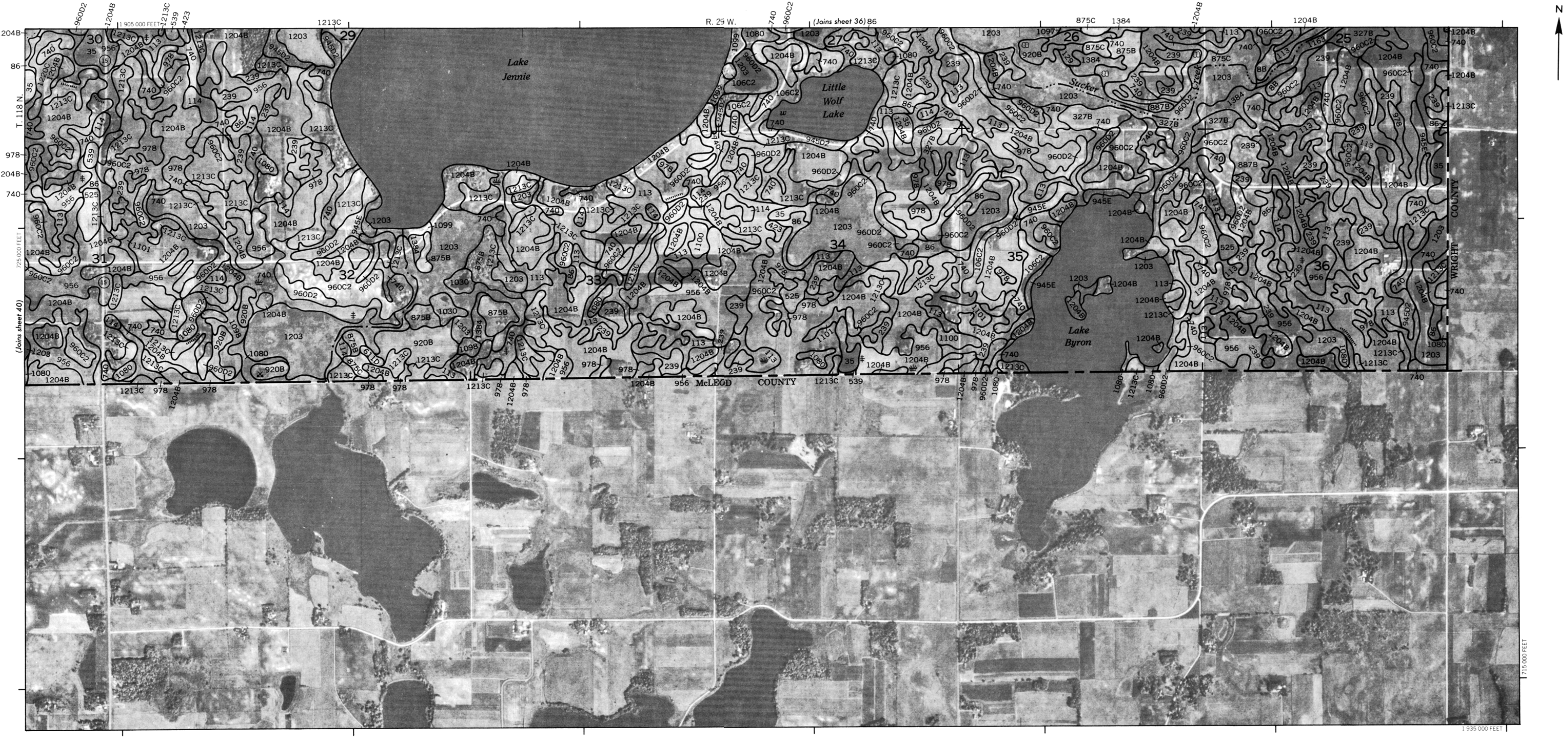
11
12

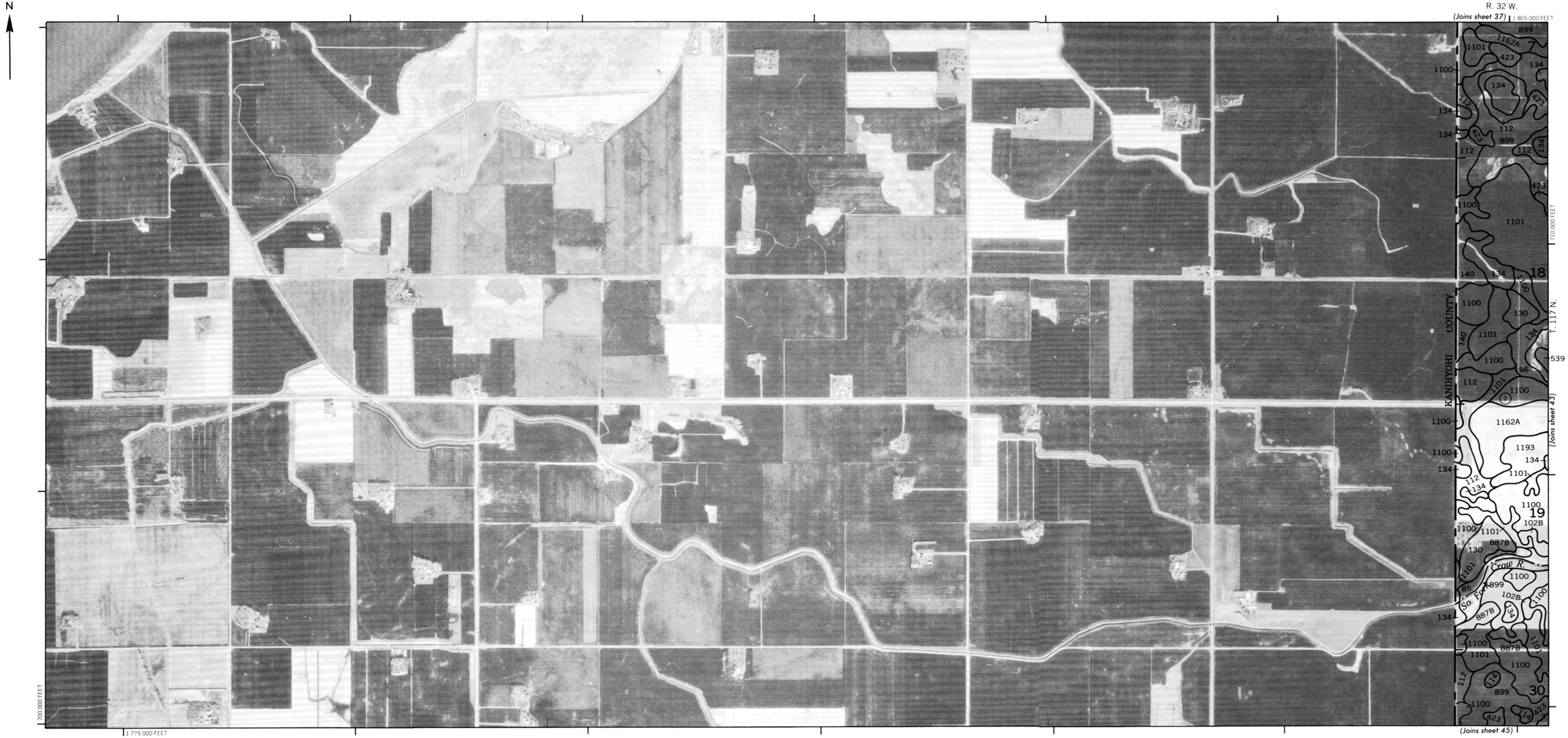
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 40

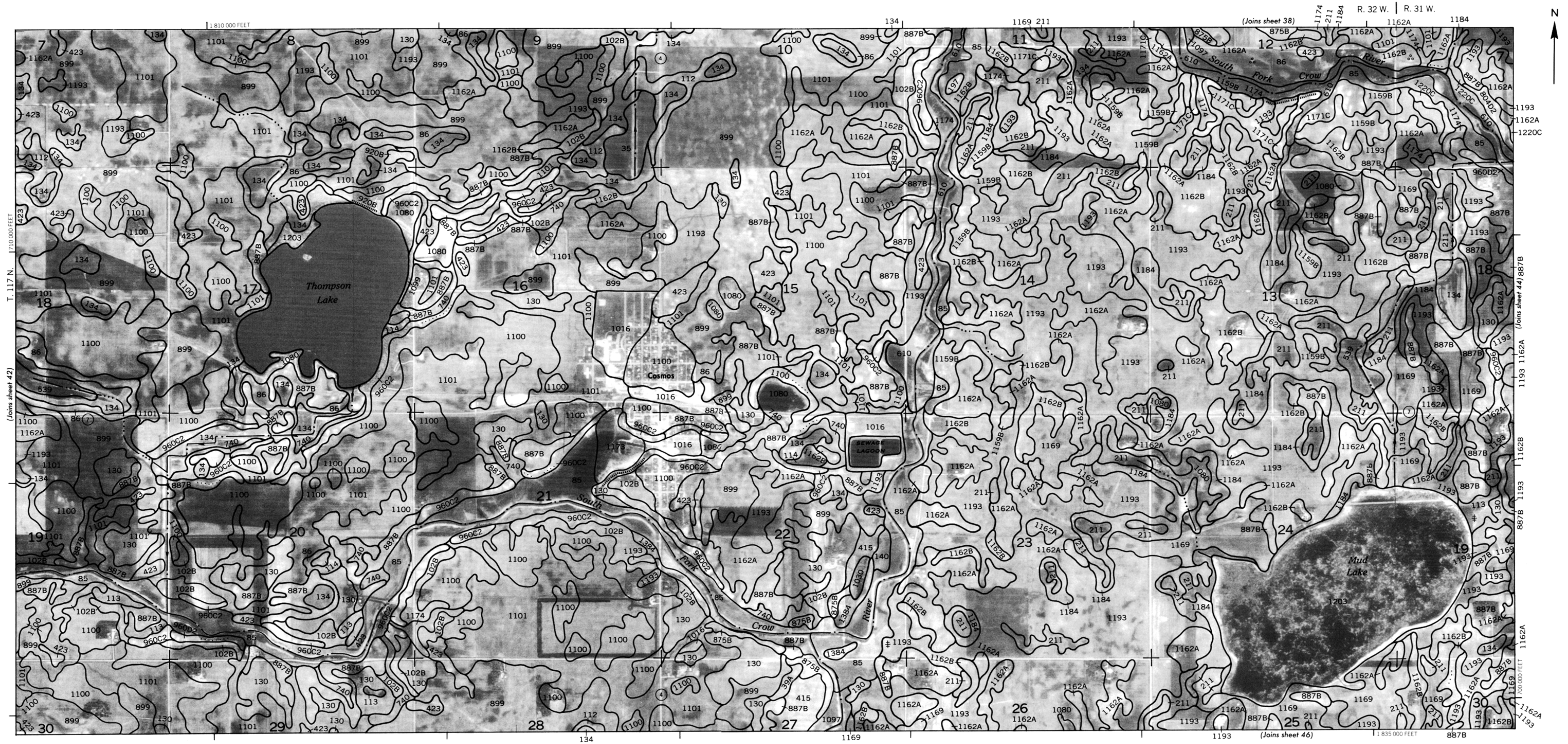

N
Willie Lake
(Joins sheet 35)
(Joins sheet 39)
(Joins sheet 41)
Fallon Lake
Cedar Lake
Belle Lake
McLEOD COUNTY
R. 30 W.
R. 29 W.
T. 118 N.
1 900 000 FEET
1 875 000 FEET
725 000 FEET
715 000 FEET
25
26
27
28
29
30
31
32
33
34
35
36
113
114
229
239
286B
525
539
612B
740
805C2
887B
920B
945D2
945E
956
960C2
960D2
978
1080
1099
1101
1203
1204B
1213C
1220C
1383A
1384

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 41

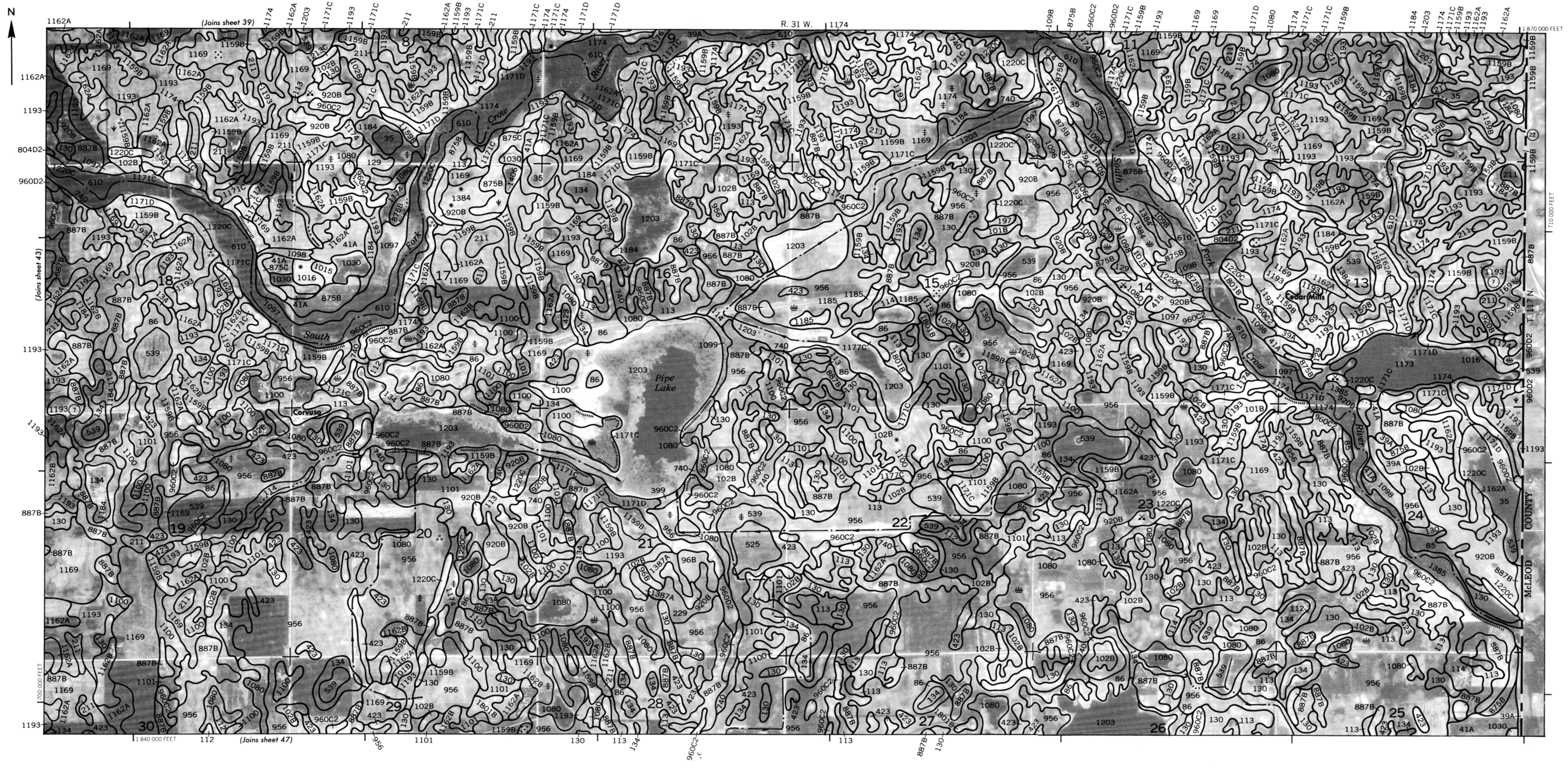

N
1 905 000 FEET
R. 29 W.
(Joins sheet 36)
T. 118 N.
725 000 FEET
(Joins sheet 40)
Lake Jennie
Little Wolf Lake
Sucker Creek
Lake Byron
McLEOD COUNTY
WRIGHT COUNTY
715 000 FEET
1 935 000 FEET
25
26
27
29
30
31
32
33
34
35
36

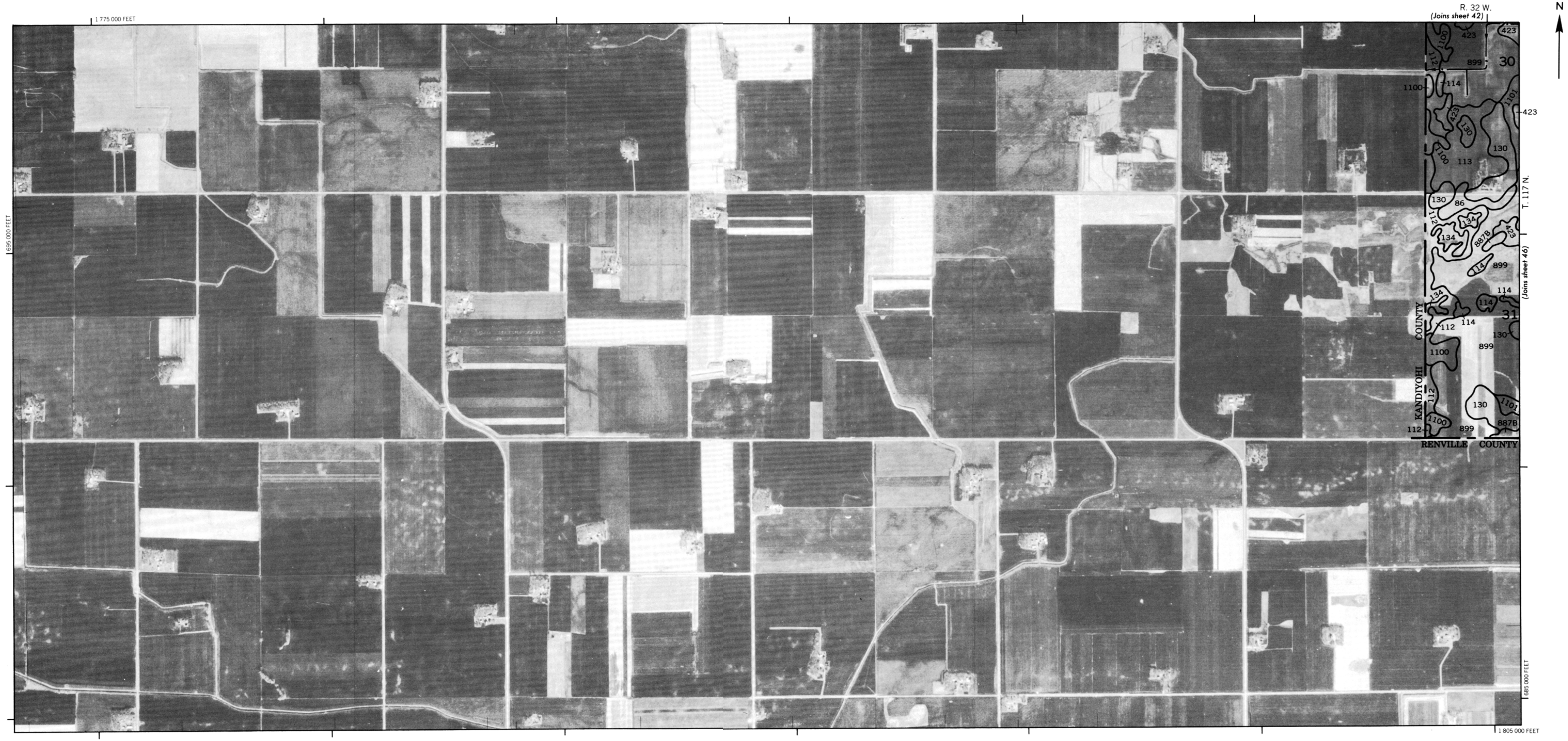
SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 42


N
R. 32 W.
(Joins sheet 37)
1 805 000 FEET
710 000 FEET
T. 117 N.
539
(Joins sheet 43)
(Joins sheet 45)
1 775 000 FEET
700 000 FEET
KANDIYOHI COUNTY
899
1162A
7
1101
423
134
1100
112
140
18
130
86
⑦
1193
19
102B
887B
Crow R.
So. Fork
85
114
30

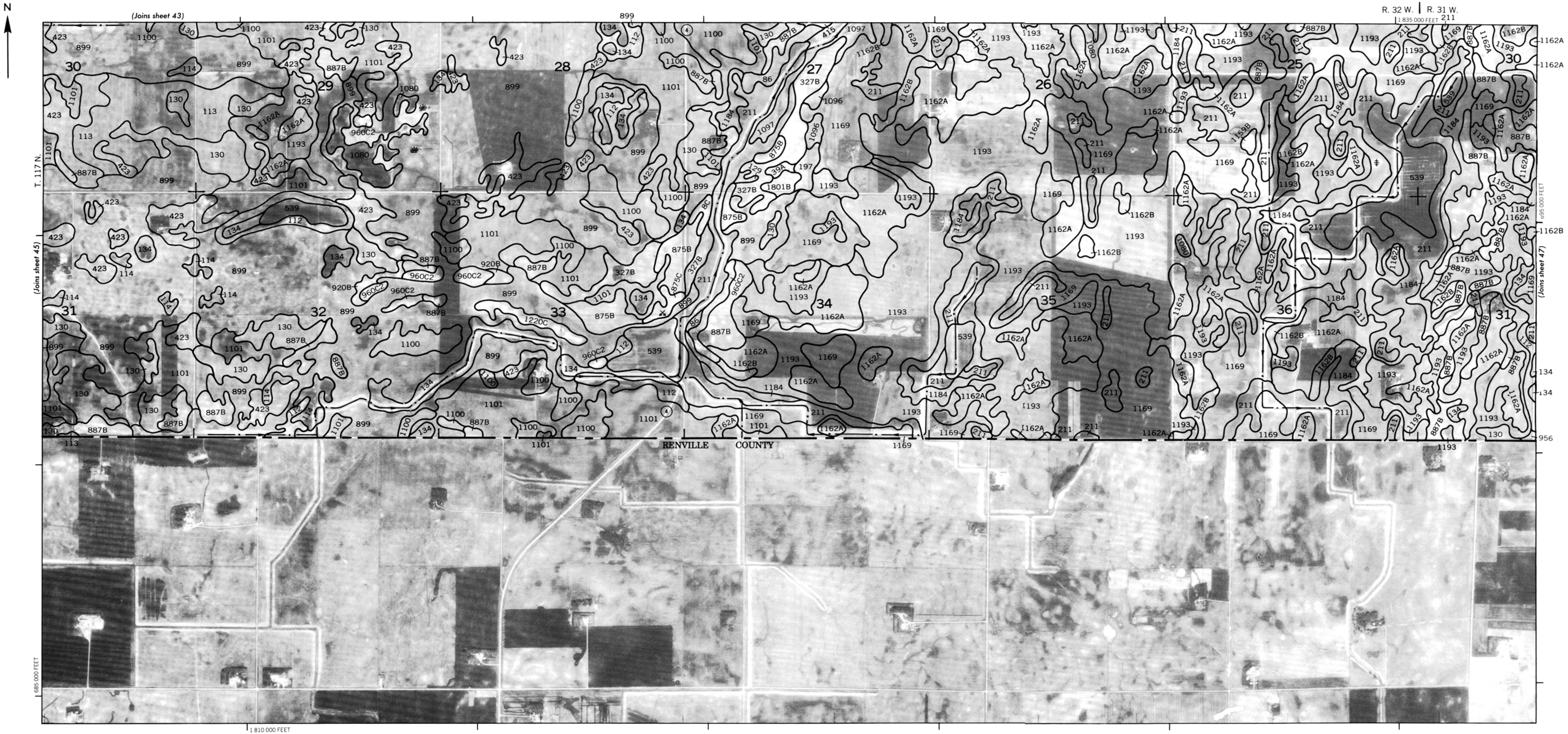

N
R. 32 W.
R. 31 W.
T. 117 N.
(Joins sheet 38)
(Joins sheet 42)
(Joins sheet 44)
(Joins sheet 46)
1 810 000 FEET
1 835 000 FEET
710 000 FEET
700 000 FEET
Thompson Lake
Cosmos
SEWAGE LAGOON
South Fork Crow River
Mud Lake

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 44

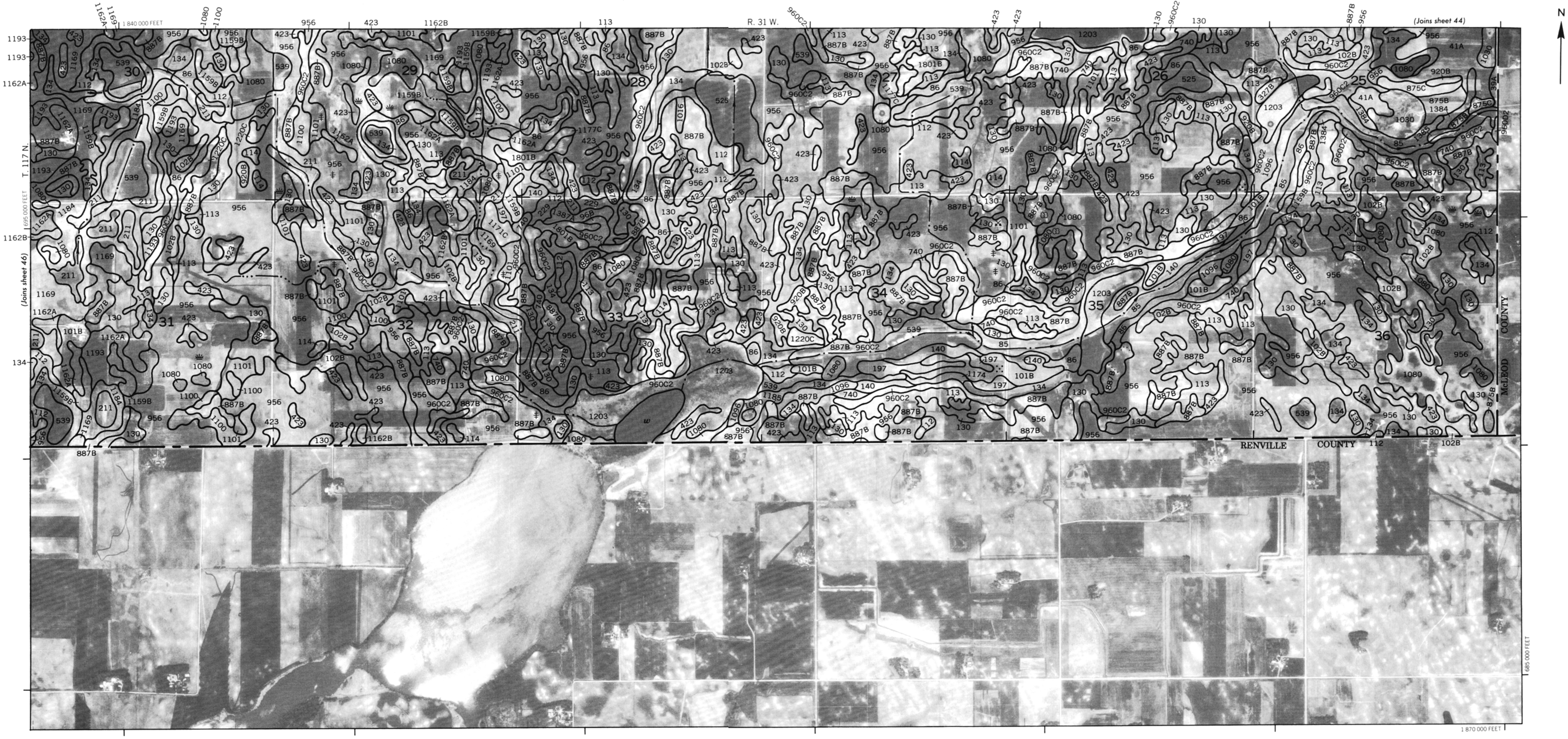

N
(Joins sheet 39)
(Joins sheet 43)
(Joins sheet 47)
R. 31 W.
T. 117 N.
1 870 000 FEET
710 000 FEET
700 000 FEET
1 840 000 FEET
Pipe Lake
Crow River
South Fork
Corvuso
Cedar Mills
McLEOD COUNTY
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30


N
R. 32 W.
(Joins sheet 42)
1 775 000 FEET
695 000 FEET
T. 117 N.
(Joins sheet 46)
685 000 FEET
1 805 000 FEET
30
31
423
1100
112
899
114
1101
130
113
86
134
887B
KANDIYOHI COUNTY
RENVILLE COUNTY

SOIL SURVEY OF MEEKER COUNTY, MINNESOTA - SHEET NUMBER 46


N
(Joins sheet 43)
R. 32 W.
R. 31 W.
1 835 000 FEET
T. 117 N.
(Joins sheet 45)
(Joins sheet 47)
695 000 FEET
685 000 FEET
1 810 000 FEET
RENVILLE COUNTY
30
29
28
27
26
25
30
31
32
33
34
35
36
31

SOIL SURVEY OF MEEKER COUNTY MINNESOTA - SHEET NUMBER 47


N
1 840 000 FEET
R. 31 W.
(Joins sheet 44)
T. 117 N.
695 000 FEET
(Joins sheet 46)
30
29
28
27
26
25
31
32
33
34
35
36
W
RENVILLE
COUNTY
McLEOD
COUNTY
685 000 FEET
1 870 000 FEET